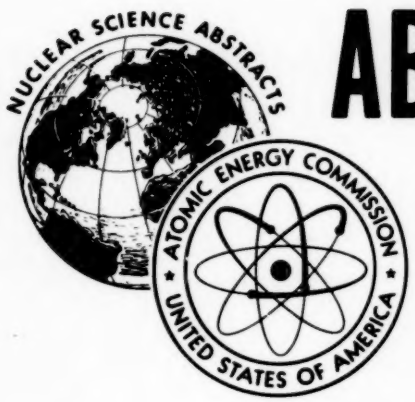
NUCLEAR SCIENCE ABSTRACTS



Volume 31 Number 1

Abstracts 1-2742

January 15, 1975

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Volume 31, Number 1, January 15, 1975

NUCLEAR SCIENCE ABSTRACTS

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CASARETT, A.P., See KALLFELZ, F.A., 30:21411
CASCI, C., Method for preliminary analysis of MHD generator performance, 30:20916 (AGARD-CP-104)

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Initial results of a holographic tomosynthesis technique for fuel-core inspection, 30:23198
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23214 (HEDL-TME-74-16) ANALYSIS OF TEMPERATURE PROFILES IN TRANSIENTLY HEATED UO_2 USING MOLYBDENUM INCLUSIONS. Wilmot, E. L. **(Hanford Engineering Development Lab., Richland, Wash. (USA)).** [nd]. Contract AT(45-1)-2170. 23p. AT.

is indexed as:

HANFORD ENGINEERING DEVELOPMENT LAB., RICHLAND, WASH. (USA)
Analysis of temperature profiles in transiently heated UO_2 using molybdenum inclusions, 30:23214 (HEDL-TME-74-16)
HEDL quarterly technical report, January--March 1974. Volume I. Materials technology, 30:21815 (HEDL-TME-74-1(Vol.1))
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Preliminary data report: post-irradiation examination of fuel pins PNL-10-23 and PNL-10-63, 30:23149 (HEDL-TME-74-23)
Prototype applications loop two years of operation, 30:20928 (HEDL-TME-74-24)

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Volume 31, Number 1 January 15, 1975

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

1 (ANL-8096, pp 155-158) APPLIED PROGRAMS. Apr 1974.

In Chemistry Division annual report, July 1972–June 1973.

Progress in studies using the MS-902 high-resolution mass spectrometer and applications of time-of-flight mass spectrometry are reported. The isotopic composition ($^{18}O/^{16}O$ and $^{13}C/^{12}C$) of CO from rainwater and ocean water is given. An isotope dilution method was developed for determining atmospheric NO_2 in the ppB range. Progress is reported on the EPR pulse radiolysis of short-lived free radicals in solution and the fluorination of biologically-active organic compounds. (JGB)

Analytical and Separations Chemistry

Refer also to abstracts 1195 and 1284.

2 DETERMINATION OF URANIUM AND THORIUM CONTENT O GRAPHITE FUEL ELEMENTS FOR HIGH TEMPERATURE REACTORS. Goergenyi, T.; Hoeflich, D. (NUKEM GmbH, 6450 Hanau, Postfach 869, Deutschland); Walter, K. H.; Jauer, H. (Hochtemperatur-Reaktorbau G.m.b.H., Mannheim (F. R. Germany)). J. Nucl. Mater.; 52: No. 1, 95-102(Aug 1974). (In German).

A method is described for determining the uranium and thorium content of spherical fuel elements for HTR's. The fuel elements are electrolytically dispersed in 6N nitric acid, while the matrix sheath surrounding the particles is destroyed by 6N nitric acid containing chromium-VI-oxide. After extraction from the solutions uranium was fluorometrically studied and thorium was photometrically studied. The procedure is suitable both for quality control in manufacture and for examination of fuel after use. (auth)

Activation and Nuclear Reaction Procedures

Refer also to abstracts 1127 and 2114.

3 (COM-74-11018) CHEMICAL ANALYSIS OF AEROSOLS AND AIRBORNE PARTICULATES. A Bibliography With Abstracts. Report for 1964–May 1974. Werner, K. G. (National Technical Information Service, Springfield, Va. (USA)). Jun 1974. 66p. (NTIS-WIN-74-045). NTIS $20.00.

This bibliography contains 60 selected abstracts of research reports retrieved using the NTIS on-line search system. It covers chemical analysis of aerosols and airborne particulate matter, as well as reports on their chemical composition. Techniques discussed range from chromatography to various methods of activation and spectroscopic analysis. Material on particle sampling techniques and particle size analysis is not included. (GRA)

4 USE OF A MICROTRON ACCELERATOR FOR THE DETERMINATION OF CARBON IN HIGH PURITY METALS. Rodionov, V. I. (Inst. for Physical Problems, Moscow); Samosyuk, V. N.; Chapyzhnikov, B. A.; Revel, G.; Fedoroff, M. Radiochem. Radioanal. Lett.; 18: No. 6, 379-385(26 Sep 1974).

The determination of carbon in high-purity iron and molybdenum by γ-activation is described. The samples are irradiated at 30 MeV with a "Microtron" accelerator. Carbon is then separated as CO_2 from an oxidizing bath. Limit of detection of 0.01 $\mu g/g$ was obtained. (auth)

5 ROLE OF NEUTRON ACTIVATION ANALYSIS IN BIOMEDICAL AND ENVIRONMENTAL STUDIES. Nadkarni, R. A. (Cornell Univ., Ithaca, NY). Radiochem. Radioanal. Lett.; 19: No. 1, 17-24(13 Oct 1974).

The technique of instrumental neutron activation analysis (INAA) with thermal neutron irradiation and counting with high-resolution detector and multichannel analyzer has been applied to the determination of up to 35 elements in diverse biological samples such as fish, plants, soil, and livers and kidneys from pigs. The elements determined include minors, essential trace elements, and some toxic elements. Several other elements which are of interest to biologists cannot be determined with simple INAA. The role of NAA is seen as much more useful in the biomedical and environmental research field rather than for the routine analysis. (auth)

6 RE-EVALUATION OF ARSENIC CONCENTRATION IN THE BIOLOGICAL STANDARDS. Nadkarni, R. A. (Cornell Univ., Ithaca, NY). Radiochem. Radioanal. Lett.; 19: No. 2, 127-134(20 Oct 1974).

Arsenic has been determined in six international biological standards by the method of instrumental neutron activation analysis. (auth)

7 ADVANTAGES OF 2-FOLD AND 3-FOLD γ-COINCIDENCE ARRANGEMENTS FOR THE SELECTIVE AND "NON-DESTRUCTIVE" DETERMINATION OF SPECIAL TRACE ELEMENTS IN ACTIVATION ANALYSIS. Herpers, U. (Koeln Univ. (F. R. Germany). Inst. fuer Kernchemie); Woelfle, R. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Nuklearchemie). Messtechnik; 82: No. 5, 111-118(May 1974). (In German).

Applications of 2-fold- and 3-fold coincidence layouts in nondestructive activation analysis are discussed. Advantages, disadvantages, efficiencies, increase of elemental selectivities, the influence of interfering factors, and a method of correcting this influence are shown. A highly selective 3-fold coincidence layout is especially applied to determine in a direct way Ir contents of iron meteorites down to 20 ppB. The detection limit was 7 ppB. The selectivity was increased by a factor of 10^3. The detection limits of further 3-fold coincidence emitters like ^{77}Ge, ^{82}Br, ^{132}Cs, ^{140}La, ^{181}Hf, ^{192}Ir, etc., are quoted and the coincidence counting rates and yields are discussed by means of a generally valid equation. (auth)

8 MANGANESE DIOXIDE AS SORBER IN THE DETERMINATION OF Ce, Ru, Zr, AND Cs FISSION NUCLIDES FROM SEAWATER BY NEUTRON ACTIVATION ANALYSIS. Sastry, V. N.; Krishnamoorthy, T. M.; Doshi, G. R.; Sarma, T. P. (Bhabha Atomic Research Centre, Bombay). Indian J. Chem.; 12: No. 2, 200-202(Feb 1974).

A method was developed for the removal of uranium fission contaminants in the determination of Ce, Ru, and Zr in seawater by neutron activation analysis. This involves a double precipitation of the initial manganese dioxide concentrate at pH 2.8 using thymol blue indicator. The decontamination factor for uranium is found to be about 500. The fission contribution for even the sensitive element cerium is no more than 10% at the concentration levels existing in seawater. The concentrations for tropical coastal waters of Bombay are found to be Ce 5.78×10^{-2} to 1.47, Zr 2.27 to 20.89 and Ru 1.71×10^{-2} to 3.61×10^{-1} μg per litre. (auth)

9 NEUTRON ACTIVATION ANALYSIS OF ARSENIC, CADMIUM, AND MERCURY IN POLLUTED RIVER WATER. Wu,

Y. Y.; Pung, T. C.; Tsai, H. T.; Wu, S. C. (Inst. of Nuclear Energy Research, Lung-Tan, Taiwan). Nucl. Sci. J. (Taiwan); 11: No. 2, 105-110(Jun 1974).

A co-precipitation method was proposed for the separation of As, Cd, and Hg in polluted river water to determine its contents by neutron activation analysis. The separation conditions of co-precipitation methods were reported in detail. Samples taken from different areas in the northern part of Taiwan were analyzed. (auth)

10 DETERMINATION OF THE MINOR ^{235}U CONTENT IN URANIUM BY THE MEASUREMENT OF FISSION NEUTRONS WITH INTERROGATION OF SUBTHRESHOLD NEUTRONS. Wen, M.; Song, P. S.; Chou, J. C. (Inst. of Nuclear Energy Research, Lung-Tan, Taiwan). Nucl. Sci. J. (Taiwan); 11: No. 2, 82-89(Jun 1974).

The total ^{235}U contents in uranium samples were determined by measuring the fission neutrons induced by subthreshold neutrons. The subthreshold neutrons (E < 100 keV) were produced in a Van de Graaff accelerator with thick metallic lithium target by the $^{7}Li(p,n)^{7}Be$ reaction. The fission neutrons were detected by the NE213 liquid scintillation neutron detector. The detector possesses good characteristics for discrimination against the low-energy neutrons and gamma rays (with pulse shape discrimination technique). A uranium sample with ^{235}U content of 1g can be assayed within 20 min with an accuracy of 2%. (auth)

11 DETERMINATION OF OXYGEN IN STEEL BY FAST NEUTRON ACTIVATION. Dincer, S.; Oezyol, H.; Sevimli, H.; Barutcugil, E. (Ankara Nuclear Research Center). Tech. J., Ankara Nucl. Res. Cent.; 1: No. 3, 111-120(Oct 1974).

The oxygen content of steel samples was determined using the $^{16}O(n, p)^{16}N$ reaction produced by the interaction of 14-MeV neutrons. A pneumatic transfer system allowing the rapid transfer of the irradiated samples to the counting position was used due to the short half-life of the product ^{16}N isotope. Mylar films placed inside a steel cylinder were used as standards for the quantitative analysis. Consequently, the oxygen amounts in eleven different samples were found between 77 ± 4 ppM and 1248 ± 95 ppM. (auth)

12 ESTIMATING THE CONFIDENCE LEVEL AND ACCURACY OF DETERMINING THE CONCENTRATION OF COPPER BY A GAMMA-SPECTROMETRIC ACTIVATION METHOD. Bakhterev, V. V.; Sen'ko-Bulatnyi, I. N.; Kharus, R. L. Izv. Vyssh. Ucheb. Zaved., Geol. Razved.; No. 6, 138-141(Jun 1974). (In Russian).

Theoretical estimates of the accuracy, confidence level, and sensitivity in determining an element under concrete geological conditions are presented for the copper isotopes ^{64}Cu and ^{66}Cu. The threshold content of copper is plotted as a function of reliability of obtaining a useful signal (confidence level). The relative error in determining a useful signal is given as a function of copper concentration in the ore. The error in determining copper, which was calculated by correlation analysis, is given as a function of copper concentration in the ore from experimental data. The data show that quantitative determinations of copper from ^{64}Cu activity are statistically more reliable than geological test data. (SJR)

13 RADIOMETRIC METHOD FOR DETERMINING ASH CONTENT OF HARD COAL USING A FAST NEUTRON GENERATOR. Loska, L.; Gorski, L. (Inst. of Nuclear Techniques, Krakow). Koks, Smola, Gaz; 18: 52-56 (1973). (In Polish)

An attempt was made to determine ash content of hard coals through activation analysis with 14-MeV neutrons from a neutron generator. The determination is based on activation of silicon and aluminum, and on the use of correlations between ash composition and its quantity. The method allows determination of ash content of coal with an average absolute error of 1.8%. (auth)

14 NEUTRON ACTIVATION ANALYSIS OF AIRBORNE DUST. Aoki, A. (Kyoto Prefectural Univ.). Kyoto Furitsu Daigaku Gakujutsu Hokoku (Rigaku); No. 23, 55-59(Oct 1972). (In Japanese).

Airborne dust was collected on membrane filters. The dust was analyzed by neutron activation method. Concentration of Mn, Na, Br, Zn, Fe, Sb, and Sc in the atmosphere and in the dust from January through June 1972 was determined. Change of the Mn, Na, and Br concentration according to season was observed at two locations in southern Kyoto and northern Kyoto. The results indicated that the concentration in the airborne dust in the southern Kyoto was about twice as much as that in the northern Kyoto, and that the concentration of Br was closely dependent upon the amount of exhaust gas of automobiles. Neutron irradiation was performed with a nuclear reactor in Kyoto University, at the output power of 5 MW, and with neutron flux density of $2.34 \times 10^{13} n/cm^2/sec$. Activated samples were measured with a Ge(Li) detector or an NaI(Tl) detector and a multichannel wave height analyzer. Identification and quantitative determination were made by photoelectric peak height and area of the peak of γ ray spectrum. The membrane filter used was Millipore RA, 4.7-cm diameter and 1.2 μ in pore size. (JA)

15 SEPARATION AND DETERMINATION OF THE TRANSPLUTONIUM ELEMENTS. II. Ch'en, K. C. Hua Hseuh Tung Pao; No. 3, 17-23(23 May 1974). (In Russian).

The isotopes of the transplutonium elements americium, curium, berkelium, californium and einsteinium may be determined by radiochemical analysis, spectrophotometry, spectrum analysis, mass spectrum analysis, coulomb sampling, activation analysis, and calorimetry. They may be separated by extraction and ion-exchange methods. (JPRS)

16 PARTIAL-BODY CALCIUM MEASUREMENTS BY IN VIVO NEUTRON ACTIVATION ANALYSIS: COMPARISONS WITH X-RAY PHOTODENSITOMETRY MEASUREMENTS OF THE RADIUS. Harrison, J. E.; McNeill, K. G.; Meema, H. E.; Fenton, S.; Oreopoulos, D. G.; Sturtridge, W. C. (Univ. of Toronto). J. Nucl. Med.; 15: No. 11, 929-934(Nov 1974).

A comparison was made of measurements of bone calcium content of bones of 71 individuals by both x-ray photodensitometry of the radius and in vivo neutron-activation analysis (IVNAA) of the trunk and upper thighs. A good correlation was found between results of measurements by the two methods though there was wide scatter about the regression line. Twenty-seven patients were measured sequentially by both techniques to assess changes in bone mineral. Again there was reasonable agreement in the majority of cases and there were marked discrepancies in only three cases. It appears that IVNAA measurements on the trunk may show changes in calcium status more quickly than do photodensitometric measurements of the radius. (auth)

Chemical and Spectral Procedures

Refer also to abstracts 108, 562, 906, 1038, 2501, 2660, 2663, and 2680.

17 (ANL-8096, pp 47-55) GEO- AND COSMOCHEMISTRY AND ARCHAEOLOGY. Apr 1974.

In Chemistry Division annual report, July 1972–June 1973.

Progress is reported on studies of the lunar samples as to the chemistry of the halogens, primordial Pb, Bi, Tl, Zn, Ru, Os, Li, Hg, and U content. Results are reported on ^{237}Np content in lunar samples, determined by isotopic dilution. In mineralogical studies, two high-halogen-containing Apollo 16 rocks were studied as to P content. Mineralogical studies on the Murchison meteorite, a Type II carbonaceous chondrite, indicate a high Cr and P content. The survey of metal compositions was extended to other Type II carbonaceous chondrites and Type III carbonaceous chondrites. Impurity distributions for three different types of copper ores are given. Impurities studied are Ag, Co, Fe, Hg, Sb, and Sc. A relationship was developed between impurity concentrations and ore types, and used to catalog a series of artifacts into sets corresponding to ore types. (JGB)

18 (COM-74-10985) PREPARATION OF REFERENCE MATERIALS FOR STATIONARY SOURCE EMISSION ANALYSIS: BERYLLIUM. Final Report. Rains, T. C.; Olson, C. D.; Velapoldi, R. A.; Wicks, S. A.; Menis, O. (National Bureau of Standards, Washington, D. C. (USA)). Mar 1974. 13p. (NBSIR-74-439). NTIS $4.00.

Techniques are described for the preparation of reference materials useful for evaluating the accuracy and precision of analytical methods for measurement of beryllium emissions from stationary sources. These reference materials consist of membrane filters upon which are deposited microgram quantities of high-fired beryllium oxide and ampoules containing soluble beryllium and suspended beryllium oxide. Methods for measurement of the beryllium content of such materials by atomic absorption spectrometry and by spectrofluorimetry are described. (auth)

19 PRECISION AND DETECTION LIMITS OF RARE-EARTH ELEMENTS IN SYNTHETIC GLASS STANDARDS BY ELECTRON PROBE ANALYSIS. Heidel, R. H. (Geological Survey, Denver, CO). Anal. Chem.; 46: No. 13, 2038-2039 (Nov 1974).

Atomic numbers, wavelengths of the respective lines, overvoltage ratios (operating voltage, E_0, to the critical absorption voltage, E_c), line and background intensities, sensitivities, and C_{DL}'s for each rare-earth in the REE synthetic glass standards are summarized. (JGB)

20 INDUCTIVELY COUPLED PLASMA: OPTICAL EMISSION SPECTROSCOPY. Fassel, V.; Kniseley, R. N. (Iowa State Univ., Ames). Anal. Chem.; 46: No. 13, 1110A-1111A; 1116A-1117A; 1120A(Nov 1974).

The combination of inductively coupled plasmas (ICP) with optical emission spectroscopy (OES) provides a promising means for multielement analysis of solutions. ICP is a special type of

plasma that derives its sustaining power by induction from high-frequency magnetic fields. Comparisons of experimentally determined detection limits for flame and ICP techniques, with both table-model single channel or large multichannel spectrometers, are tabulated. A comparison is also made between powers of detection of flame atomic absorption (AAS) and ICP–OES. Metals and metalloids can be determined at the ultratrace level on μl or μg samples with minimal interelement effects. Limits of detection are given for 61 elements; among them are Be, Ce, Dy, Er, Eu, Gd, Ho, La, Lu, Mo, Nb, Nd, Pr, Sc, Sm, Sr, Ta, Tb, Te, Th, Tm, U, Y, Yb, and Zr. (JGB)

21 NEW POLAROSPECTROGRAPHIC METHOD USED FOR TYPOCHEMICAL INVESTIGATIONS OF MINERALS. Lagerwey, A. A. F. Leiden; Rijksuniversiteit (1973). 116p. (In French).

Thesis.

A method is proposed by which well-analyzable polarized absorption and luminescence spectra may be obtained from minerals containing transition metals or lanthanides. The method is economic and suitable for practical application. The wavelengths of the spectra are in the 400 to 1200 nm range. Synthetic reference materials of the same composition as the minerals to be tested but doped with known concentrations of specific elements permit identification of the optically active ions in these minerals. In practice the method allows to distinguish between the different varieties of minerals, such as scheelite or apatite. In this way, the method may be valuable for the study of physical and chemical processes that are active during mineral formation. With the aid of the proposed method spectral analyses were made of a number of scheelites having different origins. On this basis, some varieties were identified which can be distinguished by characteristic quantitative lanthanide distributions. During the investigation, numerical data concerning the spectra of the lanthanides in scheelite were collected. These data might be of use for practical investigations. During the investigations an unknown scheelite was discovered and described; it is characterized by an unusual and strong selective enrichment with a group of heavy lanthanides, mainly dysprosium, holmium, and erbium. The crystals of this scheelite display interesting stress and rupture phenomena, which are discussed. Further investigations showed that the method may be used successfully for the classification of many other mineral varieties, especially apatites, zircon, magnesium-aluminum spinels and a number of silicates, which minerals occur as constituents in many rocks. A publication on apatite varieties classified by this method is in preparation. The facts revealed in this study give rise to a discussion of the formation conditions of scheelites at the time of origination and the consequent selective enrichment with certain lanthanides. (NL)

22 OPTIMIZATION OF THE SENSITIVITY OF SPECTROGRAPHIC ANALYSIS OF SOLUTION DRY RESIDUES BY USING INERT GASES. Silakova, V. G.; Makulov, N. A.; Manova, T. G.; Bozhevol'nov, E. A. (All-Union Scientific-Research Inst. of Chemical Reagents and Special Purity Chemicals, Moscow). Zh. Anal. Khim.; 29: No. 8, 1508-1515(Aug 1974). (In Russian).

A new camera with laminar air-cooling and a water container has been tested for spectrographic analysis in a controlled atmosphere. Mathematical multifactor experiment design has been used to find dominant factors and to choose conditions for determining 24 elements in a dry solution residue on a carbon disc with a maximum sensitivity (down to $n \cdot 10^{-9}$–$n \cdot 10^{-11}$ g). A general sensitivity optimization parameter has been chosen for simultaneous determination of a number of microimpurities by means of correlation analysis. (auth)

23 DETERMINATION OF Pu, Np, AND U BY MEANS OF AUTOMATIC COULOMETRIC TITRATION. Simakin, G. A.; Baklanova, P F.; Kuznetsov, G. F.; Chernov, A. V. (Scientific-Research Inst. of Atomic Reactions, Dimitrovgrad, Bulgaria). Zh. Anal. Khim.; 29: No. 8, 1585-1588(Aug 1974). (In Russian).

Metrologic characteristics have been examined of automatic coulometric titration of plutonium and neptunium by using amperometric indication. The possibility has been shown of indirect coulometric determination of uranium (2–10 mg) by using solid electrodes. (auth)

24 CHEMICAL-SPECTROGRAPHIC DETERMINATION OF IMPURITIES IN URANIUM WITH MAIN COMPONENT SEPARATION BY EXTRACTION INTO TRIBUTYL PHOSPHATE. Moseeva, Z. P.; Pinchuk, G. P.; Sokolov, A. B.; Karabash, A. G.; Peizulaev, Sh. I. (Physical Energy Inst., Obninsk, USSR). Zh. Anal. Khim.; 29: No. 8, 1589-1593(Aug 1974). (In Russian).

A chemical-spectrographic procedure has been worked out of determining impurities in uranium with main component separation by means of extraction into tributyl phosphate from 5–6 M HNO_3. 20-Fold concentration obtained has made it possible to increase the sensitivity of spectrographic determination of V, Nb, Ta, W to $5 \cdot 10^{-4}$; Cr to $3 \cdot 10^{-4}$; Ca, Fe, Co, Ni, Sb to $2 \cdot 10^{-4}$; Pb, Bi to $1 \cdot 10^{-4}$; Mg, Al, Ti, Mo, In, Sn, Zr to $5 \cdot 10^{-5}$; Cu, Ag, Cd to $2 \cdot 10^{-5}$; Be, Mn to $5 \cdot 10^{-6}$%. (auth)

25 SPECTROPHOTOMETRIC STUDY OF TERNARY COMPLEXES OF RARE EARTHS WITH GLYCINECRESOL RED AND CETYLTRIMETHYLAMMONIUM. Kirillov, A. I.; Shaulina, L. P.; Makarenko, O. P.; Poluektov, N. S. (Inst. of General and Inorganic Chemistry, Odessa). Zh. Anal. Khim.; 29: No. 8, 1648-1650(Aug 1974). (In Russian).

Solvent extraction of rare earths with glycinecresol red was studied in the presence of cetyltrimethylammonium. Maximum absorption of ternary complex solutions is observed at pH 8.0 to 9.0, at 616 to 620 nm. The ratio of rare earth : GCR : CTA equals 1 : 2 : 4. Some rare earths can be determined in a binary mixture with lanthanum in the presence of NaF as the masking agent. (auth)

26 DETERMINATION OF RARE EARTHS IN COBALT- AND COPPER-BASED MAGNETIC ALLOYS. Shmanenkova, G. I.; Romantseva, T. I.; Pleshakova, G. P. (State Scientific-Research and Design Inst. of Rare Metal Industry, Moscow). Zh. Anal. Khim.; 29: No. 8, 1545-1548(Aug 1974). (In Russian).

Titrimetric and spectrophotometric methods have been developed for determining rare earths in magnetic alloys such as $(Co,Cu)_5Ce$, Co_5Sm, Co_2Sm, Co_5Sm_xPr which involve preliminary cobalt and copper separation by using extraction chromatography. The relative standard deviation is not more than 0.012. (auth)

27 SPECTROGRAPHIC DETERMINATION OF RARE EARTHS IN ROCKS OF EARTH AND COSMIC ORIGIN WITH PRELIMINARY CHEMICAL CONCENTRATION FROM A SMALL SAMPLE. Laktionova, N. V.; Karyakin, A. V.; Ryabukhin, V. A.; Stroganova, N. S.; Ageeva, L. V. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 29: No. 8, 1549-1553(Aug 1974). (In Russian).

The effect of buffer and collector on the intensity of rare earth lines was examined during their spectrographic determination from a small rock or mineral sample. Some peculiarities were studied of the change of the rare earth lines intensity conditioned by the presence of calcium and yttrium atoms (collectors) in the direct current arc. The simultaneous effect of collectors, CaO and Y_2O_3, and a carrier, NaCl, was ascertained on the rare earth lines intensity. A chemical-spectrographic method is suggested of determining rare earths in rocks and minerals from a 100-mg sample. The limit of detection of rare earths is 10^{-5}–10^{-6}%; for Sm, Nd, and Dy it equals $n \cdot 10^{-4}$%. (auth)

28 PHOTOMETRIC DETERMINATION OF ZIRCONIUM WITH ARSENAZO III IN FLUORIDE MEDIA AND ORGANIC EXTRACTS. Chekmarev, A. M.; Yagodin, G. A.; Chibrikina, E. I. (Moscow Chemical-Technical Inst.). Zh. Anal. Khim.; 29: No. 8, 1563-1566(Aug 1974). (In Russian).

Arsenazo III can be used for photometric determination of zirconium present in solution in the form of hexafluorozirconate as well as for direct determination zirconium in organic extracts with aliphatic amine salts, tributyl phosphate and di-2-ethylhexylphosphoric acid. (auth)

29 POLAROGRAPHIC ESTIMATION OF MOLYBDENUM(VI) WITH THIOACETAMIDE. Farr, J. P. G.; Laditan, G. O. A. (Univ. of Birmingham, Eng.). pp 86-89 of Chemistry and Uses of Molybdenum. Mitchell, P. C. H. (Ed.). London; Climax Molybdenum Co. Ltd. (1973).

From 1st international conference on the chemistry and uses of molybdenum; Reading, UK (17 Sep 1973). See CONF-7309118-.

The polarography of acidified solutions of molybdenum(VI) and thioacetamide is described. At pH 3.0 and concentrations of Mo(VI) above 1×10^{-3}M and of thioacetamide about 1×10^{-3}M chemical reduction by thioacetamide is very slow and a polarographic catalytic hydrogen wave is easily recorded. This can be used to determine molybdate and thioacetamide. More significantly phosphate and silicate can be determined with a measure of amplification. (auth)

30 ELECTROANALYTICAL AND CATALYMETRIC MICRODETERMINATIONS OF MOLYBDATES. Jost, P.; Lagrange, P.; Wolff, M.; Schwing, J. P. (ERA, Strasbourg). pp 90-92 of Chemistry and Uses of Molybdenum. Mitchell, P. C. H. (Ed.). London; Climax Molybdenum Co. Ltd. (1973).

From 1st international conference on the chemistry and uses of molybdenum; Reading, UK (17 Sep 1973). See CONF-7309118-.

A comparative study devoted to the comparison of different methods for microdetermination of molybdates has been achieved in this laboratory: (a) polarographic reduction of Mo(VI) in citric acid medium, (b) polarographic detection of Mo(VI) in the pres-

ence of H_2O_2, (c) Coulometric reduction of Mo(VI) by cathodic generation of Ti(III), (d) cathodic deposition and anodic reoxidation of MoO_2, (e) catalymetric determination of Mo(VI) acting as a catalyst in the homogeneous reduction of BrO_3^- by I^-. These methods are compared as to the minimum detectable concentrations or quantities of Mo(VI), and the error limits are indicated. Interference of tungstates in method (d) is studied. Method (e) allows also accurate determinations of tungstates especially if tungstate is present as paratungstate B ion. Methods (a) and (c) have been used by one of us (P.J.) for the determination of the thermodynamic solubility product of $BaMoO_4$ and of the mean activity coefficients of this salt in sodium chloride solutions of increasing ionic strength (0 to 5M in NaCl). (auth)

31 DETERMINATION OF MOLYBDENUM BY ATOMIC ABSORPTION SPECTROMETRY USING A CARBON FILAMENT ATOM RESERVOIR. Dagnall, R. M. (Huntingdon Research Centre, Eng.); Johnson, D. J.; West, T. S. pp 93-96 of Chemistry and Uses of Molybdenum. Mitchell, P. C. H. (Ed.). London; Climax Molybdenum Co. Ltd. (1973).

From 1st international conference on the chemistry and uses of molybdenum; Reading, UK (17 Sep 1973). See CONF-7309118-.

A study is being made of the operating parameters and interferences in the atomic absorption determination of an element which is difficult to atomise (Mo) using a filament atom reservoir. A comparison is made with an element which is readily atomised (Zn). It is possible that this device is better suited in real situations to the determination of involatile elements such as Mo and in this instance especially using a hydrogen/nitrogen sheathing gas. There were numerous interferences in the case of Zn, but only tungsten produced a significant effect in the determination of Mo. (auth)

32 SEPARATE QUANTITATIVE DETERMINATION OF SCANDIUM AND LANTHANUM AND/OR THORIUM AND LANTHANUM IN SYNTHETIC MIXTURES BY THE COMPLEXOMETRIC METHOD OF AMPEROMETRIC TITRATION. Zhdanov, A. K.; Markhabaev, I. A.; Muminov, N. P. (Tashkent State Univ.). Uzb. Khim. Zh.; No. 4, 15-17 (1974). (In Russian)

A method was described and the results reported on the separate quantitative determination of Sc and La and of Th and La in binary mixtures by a complexometric method of successive titrations. (tr-auth)

33 EXTRACTION-PHOTOMETRIC DETERMINATION OF MOLYBDENUM. Goriach, V. F.; Marchenko, L. M. (Kiev State Univ.). Ukr. Khim. Zh.; 40: No. 9, 983-985(Sep 1974). (In Russian)

The extraction of thiocyanate complexes of Mo(V) and (VI) by dibutyl and tributyl phosphates in benzene was studied. The best was the extraction of thiocyanate complex of Mo(V) by TBP (about 95%). The composition of the complex in the organic phase corresponded to the component ratio $Mo(V):CNS^-:TBP = 1:5:3$. The molar coefficient of light absorption at 480 nm was 18,000. An extraction-photometric method for the determination of Mo in steels was developed. (tr-auth)

34 IN-LINE ANALYTICAL METHODS FOR FUEL REPROCESSING STREAMS. I. Direct Colorimetry for Uranium and Free Acid. Bhargava, V. K.; Chandrasekharan, E. S.; Iyer, R. H.; Rao, V. K.; Ramaniah, M. V. (BARAC, Bombay). Indian J. Appl. Chem.; 35: No. 1-3, 49-54 (1972).

The method makes use of the yellow colour of the uranyl ion. Determination of uranium in aqueous and organic (TBP) phases was carried out in the range 2 to 30 g/l. The method could be easily extended to much higher concentration by using differential colorimetry. Free acid could be determined in the range 0.5 to 4.5 M with an accuracy of ± 0.1 M. Effect of interfering metallic corrosion and fission product ions is also discussed. (Indian Sci. Abstr.)

35 POTENTIOMETRIC EDTA TITRATION OF MOLYBDENUM. Christova, R.; Nonova, D. (Univ., Sofia). Acta Chim. Acad. Sci. Hung.; 81: No. 4, 433-437 (1974).

On the basis of theoretical considerations as well as experimentally, the interference of sulfate ions in the potentiometric titration of EDTA with $FeCl_3$ solutions was confirmed. Thus, the method suggested by NONOVA for complexometric back-titration of molybdenum was improved, in replacing hydrazine sulfate by hydrazine hydrochloride for the reduction of Mo(VI). The method can be used for Mo quantities within 1 to several tenth of milligrams. The standard deviation is 0.04 mg. The method is applicable in the presence of Al(III), W(VI) and divalent metal ions. (auth)

36 AMPEROMETRIC DETERMINATION OF CERIUM BY CYSTEINE. Shaposhnikova, G. N.; Galfayan, N. G. (Erevan State Univ.). Arm. Khim. Zh.; 27: No. 5, 373-376 (1974). (In Russian).

The reaction of cerium (IV) with cysteine has been studied by different methods and an amperometric titration method has been worked out for the determination of cerium in minerals. (auth)

37 BIAMPEROMETRIC TITRATION OF MOLYBDENUM. Tarayan, V. M.; Acharyan, G. S.; Shaposhnikova, G. N. (Erevan State Univ.). Arm. Khim. Zh.; 27: No. 4, 279-282 (1974). (In Russian).

A biamperometric method has been worked out to determine milligram quantities of molybdenum (VI) by mercuroperchlorate. The determination may be realized in the $1.10^{-3} - 2.10^{-6}$M solutions of molybdenum. This method was used for determination of molybdenum in minerals. (auth)

38 GAZOVAYA KHROMATOGRAFIYA: BIBLIOGRAFICHESKII UKAZATEL' OTECHESTVENNOI I ZARUBEZHNOI LITERATURY (1967–1972). Chast II. Analiz Smesei, Primenenie v Khimii, Biologii i Meditsine. (Gas Chromatography: Bibliographic Index of Domestic and Foreign Literature (1967–1972). Part II. Analysis of Mixtures and Application in Chemistry, Biology, and Medicine). Litvinov, E. M. Moscow; Izdatel'stvo Nauka (1974). 379p.

This book is a continuation of bibliographies published by "Nauka" in 1962 and 1969. The literature is covered on analysis of mixtures (by class of compounds) and on the use of gas chromatography in chemistry, biology, medicine, etc. It is designed for a wide range of chemists, biologists, doctors, industrial laboratory workers, and for graduate and undergraduate students. (tr-auth)

39 MIXED COMPLEXES OF CERIUM(III) WITH NITRILOTRIACETIC ACID (NTA) AND BENZTHIURONIUM (BTU) AND THEIR USE IN ANALYSIS. Kirillov, A. I.; Turkina, L. A.; Vlasov, N. A. (Irkutsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 17: No. 9, 1291-1294(1974). (In Russian).

By an extraction-spectrophotometric method a study was made of the formation of mixed cerium(III) complexes with NTA in the presence of a large amount of BTU. Optimum pH of the extraction was 8 to 9. The ratio of components in the complex was: Ce : NTA : BTU = 1 : 2 : 3. A spectrophotometric method of determining cerium(III) in a mixture of rare earth oxides was developed. The smallest determinable amount of cerium(III) was 0.5 μg/ml. The error of the determination did not exceed 3.3%. (SJR)

40 STUDY OF THE CONDITIONS OF FORMING ORTANILIC C COMPLEXES WITH RARE EARTH ELEMENTS. Kirillov, A. I.; Shaulina, L. P.; Vlasov, N. A. (Irkutsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 17: No. 9, 1315-1318(1974). (In Russian).

Optimum conditions for formation of a rare earth complex with ortanilic C with a composition Me : R = 1 : 2 was a pH of 4.0 with spectrophotometric determination at λ = 660 nm. Instability constants and reaction sensitivity were determined for a number of rare earths. It is shown on artificial mixtures that ortanilic C can be proposed as a selective reagent for determining elements of the cerium subgroup in binary mixtures. The error of the determination does not exceed 1.4%. (SJR)

41 MASS SPECTROSCOPY OF SPUTTERED NEUTRALS AND ITS APPLICATION FOR SURFACE ANALYSIS. Oechsner, H.; Gerhard, W. (Wuerzburg Univ. (F. R. Germany). Physikalisches Inst.). Surface Sci.; 44: No. 2, 480-488(Aug 1974).

Mass spectroscopic studies of the neutral particles sputtered by Ar^+ ions at energies around 1 keV from polycrystalline targets of 11 different metals were performed, using a hf plasma maintained in pure argon at some 10^{-4} torr by electron cyclotron wave resonance as an ionizing medium as well as an effective ion source. Besides sputtered atoms Me_1 and molecules Me_2 with intensity ratios R_{21} between Me_2 and Me_1 in the order of 10^{-2} to 10^{-1}, neutral triatomic complexes Me_3 with corresponding ratios R_{31} of some 10^{-4} are found. Possible applications of the experimental method for surface analysis are discussed for previously air exposed polycrystalline Ta and Nb surfaces. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 104, 543, 600, 602, 612, 880, and 1047.

42 (BNWL-1850(PT1), pp 100-101) EVALUATION OF POSTMORTEM TISSUE SAMPLES. Nelson, I. C.; Kirby, L. J.; Thomas, V. W. Jr. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Collection of postmortem tissue samples (lung, liver, bone, and tracheobronchial lymph nodes) from individuals residing or formerly residing in the vicinity of the Hanford complex continued during the past year. The purpose of this program is to

establish baseline quantities of significant radionuclides as distributed within the body and as related to age, occupation, geographical residence, and point in time, in conjunction with establishing the environmental impact of nuclear facilities. Postmortem studies are required because present methods of in vivo measurement do not give adequate data on such important radionuclides as ^{239}Pu. Analyses of postmortem tissue samples and blood samples are also performed for the U. S. Transuranium Registry. Methods used for the isotopic analysis of α-emitting Pu isotopes in tissue samples are discussed. (CH)

43 (IAEA-163, pp 73-82) INTERCALIBRATION PROGRAMME: PROGRESS AND RESULTS TO DATE. Fukai, R.; Murray, C. N.; Ballestra, S.; Statham, G.; Asari, K. Jun 1974.

During 1970 and 1971, two seawater samples of differing radioactivity content were dispatched to 51 institutes in 27 countries. Forty-four institutes reported results of their analyses. The results indicated that large discrepancies occurred in the determination of the fission product radionuclides ^{95}Zr-Nb, ^{106}Ru, and ^{144}Ce. While the results for ^{90}Sr, ^{134}Cs and ^{137}Cs were less widely scattered, the maximum and minimum values differed by large factors. (auth)

44 SOLVENT EXTRACTION OF TIN WITH CUPFERRON AND ITS USE FOR DETERMINING TIN BY THE METHOD OF RADIOMETRIC CORRECTION WITH SUBSTOICHIOMETRIC SEPARATION. Shamaev, V. I.; Sichkar, G. A. (Moscow Chemical-Technical Inst.). Zh. Anal. Khim.; 29: No. 8, 1567-1571 (Aug 1974). (In Russian).

Extraction of tin(II) and tin(IV) with chloroform cupferron solutions has been studied. The extraction of tin(II) has been used to determine tin in its salt solutions (on the basis of the methods of radiometric titration and radiometric corrections with substoichiometric separation) and in alloys, containing antimony, bismuth, lead, tin as main components, with preliminary separation of the components (on the basis of the method of radiometric correction with substoichiometric separation). The procedure makes it possible to analyze alloys containing one tenth percent of tin with an error 4-5%. (auth)

45 SUBSTOICHIOMETRIC EXTRACTION OF ANTIMONY CUPFERRONATE. Determination of Sb in the Presence of Sn by the Method of Radiometric Correction and the Method of Calibration Curves. Shamaev, V. I.; Sichkar, G. A. (Moscow Chemical-Technical Inst.). Zh. Anal. Khim.; 29: No. 8, 1577-1584(Aug 1974). (In Russian).

Extraction of antimony (III) with chloroform cupferron solution and conditions for its substoichiometric separation by the reagent have been examined. A procedure has been developed of determining antimony based on the method of radiometric correction by using its cupferronate substoichiometric separation. The method allows determination of antimony (with preliminary separation of elements) in the presence of 200-fold amounts of tin. The substoichiometric extraction of antimony cupferronate has been used to develop a procedure based on the radiometric method of calibration curves. The procedure has been applied to the analysis of antimony-tin alloys containing one tenth antimony percent. (auth)

46 RADIOPOLAROGRAPHIC STUDY OF SOME ELEMENTS AT THE TRACE LEVEL. Rogelet, P.; David, F. (Paris Univ., Orsay, France). Radiochem. Radioanal. Lett.; 18: No. 6, 387-397(26 Sep 1974). (In French).

For developing radiochemical polarography studies, an automatic system is realized. Performances were studied with ^{54}Mn. Accuracy reaches 3%. The diffusion law and the agreement of the wave-height with Ilkovic law were checked at tracer scale for ^{54}Mn and ^{155}Eu. For $E < -2.00$ V/SCE, break of the diffusion plateau is explained by a screen effect of the supporting electrolyte. At last, the study of the concentration effect in manganese showed that tracer scale is suitable for such a method. (auth)

47 X-RAY FLUORESCENCE ANALYSIS OF BINARY ALLOYS OF COBALT WITH "LIGHT" RARE EARTHS. Feldmann, D.; Mark, W. (Bochum Univ. (F. R. Germany). Inst. fuer Werkstoffe der Elektrotechnik). Z. Metallk.; 65: No. 8, 550-553(Aug 1974). (In German).

The physical parameters influencing x-ray fluorescence analysis of binary alloys of cobalt with "light" rare earths in the technically interesting range $RECo_3$-RE_2Co_{17} are discussed. Optimized conditions are given for the quick determination of the cobalt content of a sample in a liquid solution and the determination of the Co:RE ratio of a durable solid sample. The relative accuracy of both methods is approximately 0.5%. (auth)

48 MAPPING ZONES OF RECENT TECTONIC MOVEMENTS BY MEANS OF RADIOMETRY. Gorbushina, L. V.; Ryaboshtan, Yu. S. (Moscow Inst. of Geological Surveying). Izv. Vyssh. Ucheb. Zaved., Geol. Razved.; No. 6, 176-178(Jun 1974). (In Russian).

Small- and average-amplitude movements of the earth can be tectonic or can be caused by man's activities in mining regions such as the Donetz Basin. These movements can cause cracking of house walls, cave-ins, etc. Work in the Donbass showed that these movement zones could best be detected by a radiometric method of determining the thoron and radon content on the surface of the earth. In order to confirm the magnitude of the emanation background the uranium and thorium contents were determined in the local ores. Zones with a high emanation profile were also zones of high emanation activity, and were considered unsuitable for house building. (SJR)

Separation Procedures

Refer also to abstracts 79, 84, 149, 181, 568, 577, and 585.

49 (ANL-8096, pp 8-12) SEPARATIONS AND ENVIRONMENTAL CHEMISTRY. Apr 1974.

In Chemistry Division annual report, July 1972-June 1973.

Progress in research on high-speed radiochemical separations by liquid-liquid chromatography is reported. Results of the separations of Pb(II), Bi(III), Hg(II), and Po(IV) and Cf(III), Bi(III), Po(IV), and Au(III) using tricaprylmethylammonium chloride are given. In studies on metals separation by liquid-liquid extraction, solvent dependencies and hydrogen-ion dependencies were determined for U(VI) and selected lanthanide(III) and actinide(III) elements using di-2-ethylhexyl monothiophosphoric acid, dissolved in n-heptane versus aqueous HCl. In order to obtain information on the rate and extent of penetration of radionuclides in rock, a series of prototype experiments were performed in Niagara limestone under controlled chemical conditions. Results indicate that Pu(IV) in neutral aqueous solution is strongly retained by Niagara limestone. (JGB)

50 (MLM-2168, pp 38-44) METALLURGY. 30 Aug 1974.

In Mound Laboratory activities for the Division of Physical Research: January-June 1974.

Tritium inventory considerations in lithium blankets of fusion reactors are discussed. Techniques of tritium extraction based on the reaction of tritium with a metal absorber were studied. A yttrium moving particle adsorption bed is proposed. Isotopic dilution of tritium with deuterium in the blanket is also considered. (MCG)

51 INTERACTION OF METAL CHELATES WITH THE SOLID SUPPORT IN LIQUID-LIQUID CHROMATOGRAPHY. Huber, J. F. K; Sieswerda, G. B.; Steenstra, A. J. (Univ. Amsterdam). pp 38-50 of Application of Radioactive Compounds in Column Liquid Chromatography. Sieswerda, G. B. Amsterdam: Univ. Amsterdam (1974).

The importance of radioactivity in the study of distribution processes is demonstrated. The irregular retention behaviour of the less-stable metal acetylacetonates can be explained by means of labelled compounds. The necessity of radioactivity measurements appears from the comparison with uv absorption measurements. (NL)

52 VERIFICATION OF A STOCHASTIC MODEL FOR A FROTHLESS SOLVENT ION FLOTATION USING THULIUM AND AMERICIUM. Stachurski, J. (Univ. of Mining and Metallurgy, Krakow); Szeglowski, Z. Separ. Sci.; 9: No. 4, 313-324(1974).

A stochastic model for a frothless solvent ion flotation from aqueous solutions is presented. The model takes into consideration both adsorption and desorption of ions onto bubbles passing through the aqueous solutions to the organic phase. Theoretical predictions of the stochastic model compare very well with the experimental results of "flotoextraction" of thulium and americium from citrate aqueous solutions. (auth)

53 NITRATE DEPENDENCE OF THE DYSPROSIUM DISTRIBUTION COEFFICIENT AT CONSTANT IONIC STRENGTH IN THE SYNERGISTIC SYSTEM KEROSENE/HTTA/TBP/DILUTE HNO_3. Hayden, J. G.; Gerow, I. H.; Davis, M. W. Jr. (Univ. of South Carolina, Columbia). Separ. Sci.; 9: No. 4, 337-350 (1974).

Analysis of dysprosium distribution data determined at varying nitrate concentration but constant ionic strength indicates that the dysprosium exists in the aqueous phase as $Dy(NO_3)_2^+$. The corresponding complex, which is extracted into the organic phase, is taken to be $Dy(NO_3)(TTA)_2(TBP)_2$. (auth)

54 SEPARATION KINETICS AND DETERMINATION OF TRANSITION AND REPRESENTATIVE METAL CONTAMINANTS FROM CHLOR-ALKALI CELL MERCURY WITH AMMONIUM HYDROXIDE EXTRACTION AND X-RAY FLUORESCENCE.

Dotson, R. L.; Stewart, J. D. (Dow Chemical Co., Plaquemine, LA). Separ. Sci.; 9: No. 4, 351-357(1974).

The chemical separation of transition and representative metal contaminants, e.g., Fe, Ni, Zn, and Mo, from industrial chlor-alkali cell mercury is described using ammonium hydroxide as an extractant with subsequent determination of the extracted oxides by x-ray fluorescence. (auth)

55 RAPID SEPARATION OF THORIUM FROM OTHER ELEMENTS BY LIQUID–LIQUID EXTRACTION. Moore, F. L.; Thern, G. G. (Oak Ridge National Lab., TN). Radiochem. Radioanal. Lett.; 19: No. 2, 117-125(20 Oct 1974).

A new, simple, rapid method for the separation of thorium from many other elements is based on the solvent extraction of thorium from dilute nitric acid solution with a tertiary amine dissolved in xylene. Subsequent stripping of the thorium from the organic phase with hydrochloric acid achieves very high selectivity with essentially quantitative recovery. The method is particularly suitable for the purification and determination of small amounts of thorium isotopes in uranium and protactinium solutions and in the preparation of thorium-234 tracer. (auth)

56 EXTRACTION CHROMATOGRAPHIC SEPARATION OF RADIOSTRONTIUM AND RADIOYTTRIUM. Sorantin, H.; Jettmar, A. (Inst. fuer Strahlenschutz, Seibersdorf, Austria). Radiochem. Radioanal. Lett.; 19: No. 1, 77-85(13 Oct 1974). (In German).

For the separation of radiostrontium and radioyttrium teflon tubes of 1-mm inner diameter and 4-m length were impregnated with diethylhexylphosphoric acid in toluene. Radioyttrium was fixed on the walls of the tube from a 0.1N HCl solution, while radiostrontium passed through the tube. (auth)

57 SYNERGISTIC EFFECTS IN THE SOLVENT EXTRACTION OF Tb (III) FROM MOLTEN $LiNO_3$–NH_4NO_3 EUTECTIC. Lengyel, T. (Inst. of Isotopes, Budapest). Radiochem. Radioanal. Lett.; 19: No. 1, 61-66(13 Oct 1974).

The distribution of terbium between molten lithium nitrate–ammonium nitrate eutectic and organic solvents (tri-n-butyl phosphate and di-2-ethylhexyl-phosphoric acid, respectively, both diluted with decaline) has been studied. The measurements performed have proved that the extraction proceeds by a solvation mechanism. Using the mixture of the two solvents a synergistic effect could be observed. (auth)

58 EXTRACTION OF THORIUM NITRATE COMPLEXES BY TRILAURYLAMINE AT HIGH DILUTIONS OF THE METAL. Casquinha, H. (Laboratorio de Fisica e Engenharia Nucleares, Sacavem, Portugal); Pires de Matos, A.; Maddock, A. G. Radiochem. Radioanal. Lett.; 19: No. 1, 55-59(13 Oct 1974).

An unsuccessful search has been made for metal concentration effects in the extraction of complex nitro anions by normal amine extractants. (auth)

59 RADIOCHEMICAL STUDY OF COMPLEX FORMATION BETWEEN ZINC(II) AND NITRATE. Morris, D. F. C. (Brunel Univ., Uxbridge, Eng.). Radiochem. Radioanal. Lett.; 19: No. 2, 141-145(20 Oct 1974).

Zinc-65 of high specific activity has been used in a study of interaction between Zn^{2+} and NO_3^- ions in aqueous solution. From magnitudes of the stoichiometric stability constant for formation of a 1–1 species, determined by a liquid–liquid extraction method at different temperatures, the enthalpy and entropy of ligation at 298.2°K have been estimated. The results are compatible with complexing of the outer sphere ion-pair type. (auth)

60 SEPARATION OF Au(III), Se(IV), AND Te(IV) IONS IN THIOCYANATE SOLUTIONS BY MEANS OF PARTITION CHROMATOGRAPHY AND ELECTROCHROMATOGRAPHY. Gaibakyan, D. S.; Egikyan, R. T. (Erevan State Univ.). Zh. Anal. Khim.; 29: No. 8, 1521-1525(Aug 1974). (In Russian).

The behavior, separation, and identification of microgram amounts of Au(III), Se(IV), and Te(IV) ions have been studied in thiocyanate solutions by paper thin-layer chromatography and electrochromatography. (auth)

61 USE OF SOLVENT EXTRACTION FOR THE PRODUCTION AND RECOVERY OF HIGH-PURITY AMMONIUM PARAMOLYBDATE FROM NORMAL ALKALI MOLYBDATE SOLUTION. MacInnis, M. B.; Kim, T. K.; Laferty, J. M. (GTE Sylvania Inc., Towanda, PA). pp 56-58 of Chemistry and Uses of Molybdenum. Mitchell, P. C. H. (Ed.). London; Climax Molybdenum Co. Ltd. (1973).

From 1st international conference on the chemistry and uses of molybdenum; Reading, UK (17 Sep 1973). See CONF-7309118-.

The extraction of molybdenum into tri-n-caprylyl amine from aqueous sodium molybdate solutions has been studied at both tracer and macro-concentrations. The type of molybdenum species and the mechanism involved in the extraction were determined and a process for the production of pure ammonium paramolybdate free of cationic and anionic impurities was developed. (auth)

62 SEPARATION OF SELENIUM (IV), TELLURIUM (IV), AND GOLD (III) IN ALKALINE SOLUTIONS BY THE METHODS OF PAPER CHROMATOGRAPHY AND ELECTROCHROMATOGRAPHY. Gaibakyan, D. S.; Egikyan, R. T. (Erevan State Univ.). Arm. Khim. Zh.; 27: No. 6, 474-478 (1974). (In Russian).

Separation and identification of microgram quantities of selenium (IV), tellurium (IV), and gold (III) in alkaline solution have been studied using the methods of chromatography and electrochromatography on paper and on thin layers of aluminum oxide. (auth)

63 KINETICS OF MINERAL ION EXCHANGE ON MONOCARBOXYCELLULOSE. Kaputskii, F. N.; Ovsyanko, L. M.; Kosterova, R. I.; Kaputskii, V. E. (Belorussian State Univ., Minsk). Vestsi Akad. Nauk BSSR, Ser. Khim. Nauk; No. 1, 24-26 (1974). (In Russian).

The kinetics of absorption of the K^+, Cs^+, Mg^{2+}, Cu^{2+}, Pb^{2+} and H^+ cations were studied for monocarboxycellulose (MCC) obtained by oxidizing chromatography paper, cardboard, and medical gauze with a solution of nitrogen dioxide in carbon tetrachloride. The dependence of the degree to which equilibrium is reached on the time is the same for MCC as for synthetic ion exchange resins. Exchange rate does not depend on solution concentration, but decreases with MCC density, indicating an internal diffusion mechanism of exchange. Initial infiltration occurs in the disordered region, where it is energetically favorable, with subsequent diffusion exchange in the more ordered areas. This decelerates diffusion. This sort of diffusion mechanism is confirmed by the independence of the degree to which equilibrium is reached at the initial moment in time on the dimensions of the ion. The rate at which equilibrum is established depends on the dimensions and charge of the ions with monovalent ions reaching equilibrium more quickly. Exchange rate is also directly proportional to temperature. (JPRS)

64 SEPARATION OF TRACE RARE EARTH ELEMENTS FROM HIGHLY PURE URANIUM COMPOUNDS IN ZIRCONIUM TUNGSTATE COLUMN. Hua Hseuh Tung Pao; 19: No. 6, 271-274 (15 Jun 1974). (In Russian)

A method was developed to separate trace rare earth elements from highly pure uranium compounds in zirconium tungstate columns, with the adoption of a mixed solution of hydrochloric acid and ammonium chloride as the rinsing agent. The method affords the separation of 0.2 μg of rare earth elements from 1 gram of pure uranium compounds, and allows also simultaneous thorium and titanium separations. A radioactive tracer technique was adopted to quantitatively determine the separation process. A discussion is also included on the preparations of the exchange agents, and some factors that influence the separation. (JPRS)

65 SELECTIVE EXTRACTION AND DETERMINATION OF URANIUM USING DIPHENYL ACETIC ACID. Adam, J.; Stulikova, M. (Charles Univ., Prague). Collect. Czech. Chem. Commun.; 39: No. 9, 2576-2580(Sep 1974).

A benzene solution of diphenyl acetic acid is suitable for the extraction of uranyl ions from alkaline aqueous solutions. Addition of nitrilotriacetic acid to the aqueous phase renders the extraction selective for uranium in the presence of iron(III), nickel(II), lead(II), zinc(II), cobalt(II), cadmium(II), manganese(II), copper(II), chromium (IV), and molybdenum(VI) by selective masking of these ions. Gold (III) and platinum(IV) were found to interfere slightly. Transfer of the uranium into the organic phase is virtually quantitative after two extractions. Polarographic and spectrophotometric determinations were studied; in the latter case, dibenzoylmethane is added to the organic extraction phase as a colorimetric reagent. The polarographic determination is preferably performed after re-extraction of the uranium into aqueous solution (0.5M-KCl–0.5M-HCl). The former method provides a wider useful concentration range (10^{-5} to 5.10^{-3}M-U(VI) in the extract) than the latter (10^{-5} to 2.10^{-4}M-U(VI) in the extract); however, the latter has greater accuracy (±3%) than the former (±5%) as well as being more simple. (auth)

66 EMULSION EXTRACTION OF COLLOIDAL HYDROXIDES OF NIOBIUM AND TANTALUM. Skrylev, L. D.; Petrenko, Zh. V.; Mikhailichenko, N. I.; Mokhosoev, M. V. (Donets State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 17: No. 9, 1338-1341(1974). (In Russian).

It is shown experimentally that it is possible to use an emulsion method of colloid separation in order to extract the hydroxides of niobium and tantalum formed on neutralizing potassium docaneniobate and hexatantalate with C_7–C_9 aliphatic acids. It was established that the principal factors having an effect on the emulsion extraction of niobium and tantalum hydroxides were acid concen-

tration, pH of the medium, electrolyte concentration and temperature. (SJR)

67 RUBIDIUM AND CESIUM EXTRACTION. Vasil'chenko, Z. A.; Plyushchev, V. E.; Ratner, A. I.; Reznik, A. M.; Ruzinov, L. P. (Moscow Inst. of Fine Chemical Tech.). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 17: No. 9, 1311-1314(1974). (In Russian).

A study was made of the extraction of rubidium and cesium in the presence of potassium and sodium from chloride solutions. Cesium extracts much more readily than rubidium. A mathematical method of experimental planning is presented. Equations are found by means of which it is possible to predict values of the distribution coefficients of rubidium and cesium as a function of the composition of the initial solutions. (SJR)

68 SEPARATION OF RUBIDIUM AND CESIUM ON ZIRCONYL PHOSPHATE SINTERED WITH POLYTETRAFLUOROETHYLENE. Moskvin, L. N.; Miroshnikov, V. S.; Mel'nikov, V. A.; Slutskii, G. K. Sov. Radiochem. (Engl. Transl.); 16: No. 1, 45-48(1974).

Translated from Radiokhimiya; 16: No. 1, 50-53(1974).

A comparison was made of the properties of zirconyl phosphate obtained by sintering with polytetrafluoroethylene and without it. It was shown that rubidium and cesium may be separated in acid solutions on zirconyl phosphate bound with porous polytetrafluoroethylene. (auth)

69 ISOLATION OF RADIOACTIVE CESIUM ON AMMONIUM PHOSPHOMOLYBDATE WITH POLYTETRAFLUOROETHYLENE AS BINDER. Moskvin, L. N.; Mel'nikov, V. A. Sov. Radiochem. (Engl. Transl.); 16: No. 1, 49-51(1974).

Translated from Radiokhimiya; 16: No. 1, 53-56(1974).

A method is proposed for the synthesis of an inorganic exchange material based on phosphomolybdate and polytetrafluoroethylene as the binder with any given granulometric composition. It was shown that cesium may be concentrated and isolated from salt solutions and the group chromatographic separation of alkali and alkaline earth elements is also possible. (auth)

70 ION-EXCHANGE BEHAVIOR OF POLONIUM IN ACID SOLUTIONS. Ampelogova, N. N. Sov. Radiochem. (Engl. Transl.); 16: No. 1, 52-56(1974).

Translated from Radiokhimiya; 16: No. 1, 56-61(1974).

It was established that in oxalic acid solutions (0.01-0.5 M) polonium is sorbed preferentially by an anionite, in acetic acid solutions (0.1-5 M) the sorption of polonium by a cationite and an anionite increases with an increase in the acid concentration, while in sulfuric and phosphoric acid solutions (0.1-5 M) polonium is sorbed appreciably by a cationite with sorption on AV-17 minimal in 1-3 M solutions. In 0.1-2 M solutions of perchloric acid, polonium is sorbed preferentially by a cationite. The sorption of polonium by ion-exchange resins in a series of cases does not obey the laws of ion exchange and this may be explained by the tendency of polonium for additional interactions in the ionite phase. (auth)

71 EFFICIENCY OF DEACTIVATION OF DRINKING WATER FROM CERTAIN FISSION PRODUCTS BY K-ASKANGEL. Kalandiya, A. A. Sov. Radiochem. (Engl. Transl.); 16: No. 1, 40-44(1974).

Translated from Radiokhimiya; 16: No. 1, 44-50(1974).

The degree of deactivation of water from radioactive strontium, yttrium, cesium, and other elements by K-askangel, thermally activated askangel, and natural askangel is more than 98, 97, and 83%, respectively, with a ratio of the amounts of liquid to solid phases of 25:1. Since askangel may be used repeatedly, 40 g of it is actually sufficient for the deactivation of 9-10 liter of water. Thermally activated and K-askangel may be recommended for the deactivation, concentration, and binding of radioactive isotopes from liquid radioactive wastes of the atomic industry and other materials and also as an additional absorber for an existing scheme of water purification of a centralized water supply both under normal conditions and under exceptional circumstances, which is economic and reliable. The main chemical composition and the pH of the water are hardly changed after deactivation. (auth)

72 EFFECT OF CONCENTRATION OF RADIOACTIVE ISOTOPE ON THE ABSORPTION OF STRONTIUM-90 BY K-ASKANGEL. Kalandiya, A. A. Sov. Radiochem. (Engl. Transl.); 16: No. 1, 35-39(1974).

Translated from Radiokhimiya; 16: No. 1, 39-44(1974).

In a study of the adsorption of carrier-free ^{90}Sr from aqueous solution on K-askangel it was established that as the active solution is diluted, beginning from an activity of 6250 to 98 decays/min · ml there is a gradual decrease in both the distribution coefficient K and the percent absorption of ^{90}Sr, while above this and up to complete filling of the adsorption volume the percent absorption of ^{90}Sr reaches 98% and remains constant. At macroconcentrations the adsorption rule which holds is that with an increase in the solution concentration the percent absorption and the distribution coefficient decrease, which is not observed at ultramicroconcentrations. Experimental data obtained confirmed that an increase in the concentration of the adsorbent in solution leads to a decrease in the coefficient and an increase in the percent adsorption. The hypothesis was put forward that the fact that the adsorption of $^{90}Sr \rightarrow {}^{90}Y$ is the same is caused by the presence of sulfates and hydroxides, mainly of Group I metals, in the K-askangel. A ratio of the amount of liquid phase to the amount of solid of 25:0.25 is most advantageous for freeing water from radioactive contamination by strontium with K-askangel. K-Askangel has an extremely high absorption capacity of about 27 mg-equiv/g. (auth)

73 SEPARATION OF ACTINIDES AND LANTHANIDES ON ZIRCONIUM PHOSPHATE. V. Isolation of Berkelium. Shafiev, A. I.; Efremov, Yu. V.; Yakoviev, G. N. Sov. Radiochem. (Engl. Transl.); 16: No. 1, 31-34(1974).

Translated from Radiokhimiya; 16: No. 1, 34-38(1974).

Berkelium(IV) and other tetravalent elements may be sorbed quantitatively from acid solutions on a small column of zirconium phosphate. Washing the column with 1 N HNO_3 in the presence of an oxidant makes it possible to achieve a high degree of purification (more than 10^7) from a series of di-, tri-, penta-, and hexavalent elements. Complete desorption and concentration are achieved through the rapid reduction of $Bk^{(IV)}$ with 0.5-2 N HNO_3-1-2% H_2O_2 solution. (auth)

74 REACTION OF AMERICIUM(III) WITH OXALATE IONS DURING ADSORPTION ON BARIUM OXALATE. Bykhovskii, D. N.; Petrova, I. K. Sov. Radiochem. (Engl. Transl.); 16: No. 1, 27-30(1974).

Translated from Radiokhimiya; 16: No. 1, 31-34(1974).

A study was made of the relation of the adsorption of Americium(III) on the surface of barium oxalate crystals to the concentration of oxalate ions in solution. It was shown that the observed relation is explained satisfactorily on the basis of the hypothesis that americium is transferred onto the surface of the crystals in the form of $Am(C_2O_4)_2^-$. (auth)

75 HYDROXIDE COLLECTORS IN RADIOCHEMISTRY. VII. Reduction Products of Lithium and Cesium Permanganates. Lyubimov, A. S.; Egorov, Yu. V. Sov. Radiochem. (Engl. Transl.); 16: No. 1, 23-26(1974).

Translated from Radiokhimiya; 16: No. 1, 27-30(1974).

It was shown that manganese dioxide (MD) precipitates obtained by reduction of cesium and lithium permanganates in aqueous solutions always contain Mn^{2+} ions and the cation of the corresponding permanganate or coagulant. It was established that the limiting content of divalent manganese in MD precipitates decreases with an increase in the ionic potential of the cation of the starting permanganate. The limiting absorption of the cation of the permanganate or coagulant corresponds to the capacity of two groups of sorption centers of the MD (OH groups). Equations were proposed relating the fraction of the component of the manganese dioxide ($Mn^{(II)}$, $Mn^{(IV)}$ and C^{x+}) and the initial concentration of the permanganate. The parameters of these equations were calculated. (auth)

76 EXTRACTION POWER OF SULFOXIDES. IX. Basicity of Sulfoxides, Their Extraction Properties, and Position in the Series of Organic Oxides. Rozen, A. M.; Murinov, Yu. I.; Nikitin, Yu. E.; Pilyugin, V. S. Sov. Radiochem. (Engl. Transl.); 16: No. 1, 115-117(1974).

Translated from Radiokhimiya; 16: No. 1, 118-120(1974).

A basicity scale was constructed for sulfoxides. It was shown that the extraction power of noncyclic and cyclic sulfoxides (with respect to uranyl nitrate) correlates with the basicity of the oxygen. Data for neutral organophosphorus compounds also fit in with the correlation obtained. It was shown that the basicities of sulfoxides are closest to those of phosphonates. A relation was found of the extraction power and the basicity of noncyclic sulfoxides to the sum of the electronegativities of the substituent groups. (auth)

77 SORPTION OF URANIUM FROM SEAWATER ON TITANIA GEL. Ryabinin, A. I.; Doroshenko, G. A.; Lazareva, E. A. Sov. Radiochem. (Engl. Transl.); 16: No. 1, 113-114(1974).

Translated from Radiokhimiya; 16: No. 1, 116-118(1974).

A simple economic method of preparing titania gel is described, and the results of testing it as a sorbent for the isolation of uranium from Black Sea water are given. (LK)

Inorganic, Organic, and Physical Chemistry

Refer also to abstract 153.

78 (ANL-8096, pp 84-93) STABLE ISOTOPE STUDIES. Apr 1974.

In Chemistry Division annual report, July 1972–June 1973.

Progress is reported in studies on the role of chlorophyll in the light-conversion act of photosynthesis and the structure, function, and properties of proteins involved in electron transport. Deuterium labeling was used in the assignment of the ENDOR proton–electron coupling constants of the chlorophyll cation free radical. Variable-concentration spectra are given for bacteriochlorophyll in monomeric and aggregating solvents. In studies on chloroplast pigments and algal systematics, major and minor carotenoids of dinoflagellates were identified. Carbon-13 magnetic resonance spectra are presented for phycocyanin in trifluoroacetic acid(TFA) and of reduced and oxidized algal cytochrome in H_2O buffer. Experiments in the cultivation of ^{13}C-enriched tobacco and morning glory plants indicated the following possible effects of isotope enrichment: slower growth and development, decreased production of flowers and seed, and abnormalities in the morphology of pollen. (JGB)

79 CHEMISTRY AND USES OF MOLYBDENUM. Conference Held at Reading, England, September 17–21, 1973. Mitchell, P. C. H. (Ed.). London; Climax Molybdenum Company Ltd. (1973). 293p. (CONF-7309118-).

The 61 lectures and papers presented are compiled. The topics discussed were Mo oxygen compounds, Mo species in aqueous solution, compounds of Mo with C, N, and S donors, catalysis, and Mo in biological systems. At the end of the compilation written comments on some of the papers are given. Separate abstracts were prepared for six of the papers. (JSR)

For abstracts of individual papers see: 29–31, 61, 85, and 1089.

80 METODY ELEMENTO-ORGANICHESKOI KHIMII. Podgruppy medi, skandiya, titana, vanadiya, khroma, margantsa. Lantanoidy i aktinoidy. Kniga pervaya. (Methods of organometallic chemistry. Subgroups of copper, scandium, titanium, vanadium, chromium, manganese. Lanthanides and actinides. Book one). Nesmeyanov, A. N.; Kocheshkov, K. A. (eds.). Moscow; Izdatel'stvo Nauka (1974). 471p.

Methods for the synthesis, the chemical and physical properties, and characteristic reactions of the metallo-organic compounds of the transition elements of the I to VII groups and of the lanthanides and actinides are described. Each chapter contains an extensive bibliography. In Book 1 compounds of Cu, Ag, Au, Sc, Ti, Zr, Hf, V, Nb, and Ta are discussed. (JSR)

81 METODY ELEMENTO-ORGANICHESKOI KHIMII. Podgruppy medi, skandiya, titana, vanadiya, khroma, margantsa. Lantanoidy i aktinoidy. Kniga vtoraya. (Methods of organometallic chemistry. Subgroups of copper, scandium, titanium, vanadium, chromium, manganese. Lanthanides and actinides. Book two). Nesmeyanov, A. N.; Kocheshkov, K. A. (eds.). Moscow; Izdatel'stvo Nauka (1974). 497p.

In Book 2 compounds of Cr, Mo, W, Mn, Tc, Re, and the lanthanides and actinides are considered. (JSR)

Chemical and Physicochemical Properties

Refer also to abstracts 1088 and 1272.

82 (ANL-8096, pp 106-110) FUNDAMENTAL STUDIES ON IMPORTANT LIQUIDS. Apr 1974.

In Chemistry Division annual report, July 1972–June 1973.

A search for dilute paramagnetic salts for refrigeration below 2 m°K is underway. Cerium thiocyanate tetra-triphenylphosphine oxide (Phosox) is regarded as a promising candidate. Progress is reported on studies on molecular interactions and dynamic processes in liquid water and in aqueous solutions. Present conclusions are given with respect to the nature of the molecular processes occurring in low-temperature water and based on an inference from the isotope effect for the spin-lattice relaxation in D_2O and $H_2{}^{17}O$. It is concluded that the hydrogen-bonded structure associated with the relaxing molecules is well defined in the liquid, and that there is a significant difference in the nature of relaxation processes in water and ice. (JGB)

83 (ANL-8096, pp 113-121) STRUCTURAL CHEMISTRY. Apr 1974.

In Chemistry Division annual report, July 1972–June 1973.

In studies on the chemistry of irradiated fuel materials, the structures of Cs_2MoO_4 and $Cs_2Mo_2O_7$ were determined by x-ray crystallography. Main accomplishments in neutron crystallography include the discovery of a linear asymmetric bifluoride ion, a conclusive demonstration of the existence of stable xenon–chlorine bonding at ambient temperature, and the determination of the geometry of the deutero-oxonium ion. Results of deuterium isotope replacement studies on the D_3O^+ ion in p-toluenesulfonic acid monodeuterate, $D_3O^+CH_3C_6H_4SO_3^-$, are reported. The detailed structure of XeO_2F_2 was established. Neutron diffraction studies of $Cs_3(XeO_3Cl_2)_4 \cdot Cl$, $NiSiF_6 \cdot 6H_2O$, and $CuSiF_6 \cdot 4H_2O$ are reported. Results of studies on the magnetic and crystal structure of $ThNi_2Co_3$ and $ThNi_3Co_2$ are given. A neutron-structure determination of Na_2C_2 revealed the shortest C–C bond distance ever observed. Progress in neutron and Mössbauer studies of PrC_2, DyC_2, and EuC_2 is reported. (JGB)

84 SLUGGISH ELECTRONS IN LIQUID IODINE. Ludwig, J. Groningen, Nethelands;Rijksuniversiteit (1974). 81p.

Thesis.

The liquid iodine system, pure and doped, was studied using a number of different techniques. A description is given of the purification of the materials used, while possible influences of electrode and vessel materials are also considered. A few incidental measurements concerning the density and viscosity and a number of electrical measurements are described. Aside from the usual conductivity measurements, from which to a "normal" electrolyte behaviour for the lower concentrations could be concluded, transfer measurements were also carried out, which proved the special importance of the negatively charged species. Then a method is described by which very pure iodine can be obtained. It will be shown that in this material the origin of the charge carriers is not clear. Frequency-dependent measurements are described. From the thermoelectric measurements some semi-quantative conclusions are drawn on the nature of the negative charge carrier. The manner in which the electrons are present in molten iodine is closely connected with the liquid structure, which is also discussed. Some attention is given to the positive charge carriers and the interactions with their environment, in one case the cation being paramagnetic. Results are compared and a model is presented which explains the experimental facts rather well. Chapter III presents some earlier work, also published in J. Chem. Phys. 52 (1970) 2302, which has been carried out in connection with previous investigations on solid iodine. The results completely confirm the model presented before by Bargeman and Kommandeur. (NL)

85 PHASE DIAGRAM OF THE $NH_3-MoO_3-H_2O$ SYSTEM. Hallada, C. J. (Climax Molybdenum Co. of Michigan, Ann Arbor). pp 52-55 of Chemistry and Uses of Molybdenum. Mitchell, P. C. H. (Ed.). London; Climax Molybdenum Co. Ltd. (1973).

From 1st international conference on the chemistry and Uses of molybdenum; Reading, UK (17 Sep 1973). See CONF-7309118-.

The solubility isotherms of the $NH_3-MoO_3-H_2O$ system were determined between 0 and 75°C. The range of ammonia concentrations over which ammonium paramolybdate, $(NH_4)_6Mo_7O_{24}.4H_2O$, exists as a solid in equilibrium with a saturated solution decreases with increased temperature. Ammonium dimolybdate, $(NH_4)_2Mo_2O_7$, was not found up to 50°C as a solid in equilibrium with a saturated solution. However, at 75°C, the range of ammonia concentrations over which ammonium dimolybdate exists as a solid in equilibrium with saturated solution is greater than the range over which ammonium paramolybdate exists as an equilibrium solid. (auth)

Isotope Effects

Refer also to abstract 114.

86 ADDITION OF WATER TO 1-ALKYNYLAMINES. Kinetics and Mechanism. Verheist, W. F.; Drenth, W. (Univ., Utrecht). J. Amer. Chem. Soc.; 96: No. 21, 6692-6697(16 Oct 1974).

The addition of water to $PhC \equiv CNR_2'$ is investigated in water–dioxane (10.6 : 1) by stopped flow spectrophotometry. In basic medium the reaction is general acid catalyzed with a Brønsted α of 0.74. This behavior indicates rate-determining proton transfer to carbon. This conclusion is supported by the solvent deuterium isotope effect $k(H_2O)/k(D_2O)$ of approximately 4 and by the effect of substituents R'. The highly negative entropy of activation of the reaction in which water is the general acid ($\simeq -39$ eu) is in line with the slow step being essentially an ionization. Proton transfer to ynamines is faster than to acetylenic ethers by approximately six powers of ten. It is also much faster to ynamines than to enamines. In acetic acid–sodium acetate buffer the rate is 10^4 times slower than expected from a Brønsted extrapolation. This retardation is ascribed to complex formation between ynamine and acetic acid, which interpretation is supported by an uv shift. In this complex nitrogen is protonated; $K_a \simeq 10^{-5}$ M from kinetic as well as spectrophotometric data. Subsequently, this proton is transferred to carbon in a reaction catalyzed by either acetic acid or hydroxyl ions. The acetic acid catalysis could be an example of bifunctional catalysis. (auth)

87 QUENCHING OF PHOTOEXCITED FLUORENONE BY META- AND PARA-SUBSTITUTED ANILINES AND MONO-N-SUBSTITUTED ANILINES. Some Linear Free-Energy Relationships. Parsons, G. H. Jr.; Mendelson, L. T.; Cohen, S. G. (Brandeis Univ., Waltham, MA). J. Amer. Chem. Soc.; 96: No. 21, 6643-6647(16 Oct 1974).

Fluorenone is photoreduced by 0.01 M N,N-dimethylaniline in benzene, $\varphi = 0.59$, $k_{ir} = 4.7 \times 10^8$ M^{-1} sec^{-1}, and by 0.0086 M triethylamine in benzene, $\varphi = 0.83$, $k_{ir} = 1.7 \times 10^8$ M^{-1} sec^{-1}. Eleven meta- and para-substituted anilines were studied as quenchers for these photoreductions; values of k_q varied from 8×10^7 M^{-1} sec^{-1} for p-CN to 1.4×10^{10} M^{-1} sec^{-1} for p-OC_2H_5. A plot of log k_{ir} vs. σ^+ is linear from p-OEt to p-$COCH_3$, $\rho = -0.96$; m-CF_3, p-CO_2Et, and p-CN lead to larger decreases in rate. In quenching by aniline NH_2 and aniline ND_2 $k_H/k_D = 1.3$. Mono-N-substituted anilines are also quenchers for fluorenone; values of k_q are $1-7 \times 10^9$ M^{-1} sec^{-1} for five mono-N-alkylanilines and 8.9×10^9 M^{-1} sec^{-1} for diphenylamine. From the linear relation between σ^+ and known ionization potentials, IP, of a series of meta- and para-substituted anilines, ionization potentials of others are estimated. Values of log k_{ir} and IP for N-methylaniline and diphenylamine fit the linear relationship between log k_{ir} and IP of meta- and para-substituted anilines. Values of k_{ir} are higher and less sensitive to σ or IP than are those of corresponding compounds lacking aromatic NH. The results are discussed in terms of development of partial positive charge of N and partial hydrogen transfer from aromatic N in the quenching of the triplet. Light-induced reactions of fluorenone and biacetyl with amines are compared, and the relevance of the pK_a of the ketyl radical to reduction and quenching is indicated. (auth)

88 ISOTOPE EFFECTS IN THE HYDROXYLATION OF PHENYLETHYLAMINE BY DOPAMINE β-HYDROXYLASE. Bachan, L. (Howard Univ., Washington, DC); Storm, C. B.; Wheeler, J. W.; Kaufman, S. J. Amer. Chem. Soc.; 96: No. 21, 6799-6800(16 Oct 1974).

The (R)- and (S)-[β-^{2}H]phenethylamine were prepared and their absolute stereochemistry was examined. The primary and secondary isotope effects in its hydroxylation were determined. (JSR)

89 STRIKING DEUTERIUM EFFECT IN PHOSPHORUS CHEMILUMINESCENCE. Identification of the Emitting Species. Van Zee, R. J.; Khan, A. U. (Michigan State Univ., East Lansing). J. Amer. Chem. Soc.; 96: No. 21, 6805-6806(16 Oct 1974).

Under conditions similar to naturally occurring phosphorus chemiluminescence, a substitution of heavy water for water in the reaction of P, O_2, and water was made and a marked frequency shift and changes in the intensity distribution were observed in the chemiluminescence spectra. The emitting species in the visible and ultraviolet region were identified. The discrete visible bands show the most marked deuterium effect. (JSR)

90 ALKYCLCARBENE COMPLEX OF TANTALUM BY INTRAMOLECULAR α-HYDROGEN ABSTRACTION. Schrock, R. R. (Du Pont de Nemours and Co., Wilmington, DE). J. Amer. Chem. Soc.; 96: No. 21, 6796-6797(16 Oct 1974).

A thermally stable neopentylidene complex of Ta was prepared and isolated. The essential structural features of the complex were determined by nmr. Deuterium labeling techniques were used to study the mechanism of its formation and showed a primary deuterium isotope effect. A possible mechanism was proposed. The results also clearly indicate that under some conditions alkylidene complexes are stable and that α-hydrogen abstraction is a viable mode of decomposition of transition metal alkyl complexes. (JSR)

91 INFLUENCE OF INTERMOLECULAR VIBRATIONAL RELAXATION IN LIQUIDS ON IR BANDSHAPES. van Woerkom, P. C. M. Leiden; Rijksunivesiteit (1974). 89p.

Thesis.

The experimental data obtained were discussed in terms of intermolecular vibrational relaxation. It was suggested that transition dipole-transition dipole coupling may account for the observed isotopic dilution effects. An important result with respect to previous work is the significant temperature dependence of the intermolecular vibrational relaxation. This fact gives rise to the conclusion that the Rakov method to separate the rotational and vibrational linewidth is invalid. The experimental results are confirmed qualitatively by the theoretical calculations. The influence of intermolecular vibrational relaxation due to interoscillator coupling was calculated approximately using a simplified model for the liquid. The theory shows the dependence of the isotopic dilution effect on the integrated absorption intensity, the temperature dependence and the linear dependence on the concentration. Furthermore it is explicitly shown that the a priori separation of the dipole moment correlation function into independent rotational and vibrational parts yields a different time dependence. The agreement between theory and experiment is underlined by a quantitative comparison. This is performed for some data on CH_2Cl_2. Because the experimental error on the isotopic dilution effect is relatively large for the low concentrations the comparison will be confined to solutions with a high concentration of CH_2Cl_2 molecules. (NL)

92 ISOTOPE EFFECT FOR THE THERMAL F + H_2 REACTION: AN ARRHENIUS KINETICS EXPERIMENT BASED UPON NUCLEAR RECOIL TECHNIQUES. Grant, E. R.; Root, J. W. (California Univ., Davis (USA). Dept. of Chemistry). Chem. Phys. Lett.; 27: No. 4, 484-489(15 Aug 1974).

Modified nuclear hot atom techniques have been used to characterize the kinetic isotope effect for the reaction of atomic fluorine with molecular hydrogen under conditions of thermal initiation. The following Arrhenius temperature dependence was obtained for the isotopic rate constant ratio: $k_{H_2}/k_{D_2} = (1.11 \pm 0.05) \exp[(356 \pm 26)/RT]$ over the temperature range 303-475°K. (auth)

93 ORDERING OF CARBON-HYDROGEN BOND STRENGTHS USING ISOTOPE EFFECTS. Butler, M. M. Houston, TX; Rice Univ. (1974). 67p. University Microfilm Order No. 74-21,255.

Thesis (Ph. D.).

Excess thiophenol reacts at room temperature with 4-triphenylmethyl-1-diphenylmethylene-2,6-cyclohexadiene (I) to produce triphenylmethane and phenyl triphenylmethyl sulfide. At -15 and -25°, p-benzhydryltetraphenylmethane (II), an isomer of I, is also formed. When tritium is present in the SH position, both triphenylmethane and II are labeled showing that II cannot result from an intramolecular isomerization for it contains tritium derived from the thiophenol. The temperature dependence of the isotope effect is normal between 0 and 40°C and is represented by the equation $k_H/k_T = 0.187 \exp(2590 \text{ cal } RT)$. The temperature dependence of the isotope effect at high and low temperatures is abnormal and understood. The isotope effect at 25.0° of $k_H/k_T = 14.9$ is larger than would be calculated ($k_H/k_T = 11.5$) for complete loss of zero-point energy of a typical SH bond. Excess 2-mesitylenethiol also reacts with I to produce triphenylmethane and mesityl phenyl sulfide. The isotope effect for this reaction is 25.2 at 25.0°. The temperature dependence of the isotope effect is normal between 0 and 40° and is represented by the equation $k_H/k_T = 0.271 \exp(2700 \text{ cal } RT)$. Several isotope effects are presented in the atom-transfer reaction of hydrogen from sulfur to carbon. The overall reaction is the radical chain addition of R^1SH to $R^2R^3C{=}CH_2$ to yield the sulfide, $R^2R^3CHCH_2SR^1$. The results are understandable if $D_{RH} - D_{SH}$, the difference in the bond strengths in the reagent and products, is a good measure of the transition-state symmetry. The large range of isotope effects is noteworthy. The values can be understood if the SH bond strength in the thiophenol falls between the CH bond in the product with $R^2 = p\text{-}MeOC_6H_4$, $R^3 = H$ and that with $R^2 = R^3 = p\text{-}ClC_6H_4$. Assuming that only the arylated systems might have a CH bond weaker than the SH bond, and that a maximum isotope effect is expected when $D_{SH} - D_{CH}$, we can use the results of order D_{RH} in the forming bond. $PhCH_2SH$ has a stronger SH bond than thiophenol and would, therefore, be expected to give different isotope effects. The results show that the isotope effects with $PhCH_2SH$ also follow the order derived from the thiophenol isotope effects, except for the addition of acrylonitrile, for which an ionic mechanism is likely. The maximum isotope effect falls at an earlier position in the order, as expected. The failure of di-p-anisylethylene to react is consistent with the presence of an endothermic step in the chain. Experimental methods were devised to minimize error from temperature uncertainty and there were controls to show the source of the hydrogen atom transferred. (Diss. Abstr. Int., B)

Isotope Exchange and Isotope Separation

Refer also to abstracts 50 and 149.

94 (ANL-8096, pp 159) UTILIZATION OF SPECIAL FACILITIES. Apr 1974.

In Chemistry Division annual report, July 1972-June 1973.

Isotope separation applications are briefly reported. (JGB)

95 (MLM-2168) MOUND LABORATORY ACTIVITIES FOR THE DIVISION OF PHYSICAL RESEARCH: January-June 1974. (Mound Lab., Miamisburg, Ohio (USA)). 30 Aug 1974. Contract AT-33-1-GEN-53. 47p. Dep. NTIS $4.00.

Separate abstracts were prepared for the six sections of this report. (LK)

For abstracts of individual sections see: 50, 96-99, and 185.

96 (MLM-2168, pp 8) CARBON ISOTOPE SEPARATION. 30 Aug 1974.

In Mound Laboratory activities for the Division of Physical Research: January–June 1974.

During fiscal year 1974, the distillation system produced 580 g of CO with ^{13}C enriched to 90%. During this report period 683 liters of methane (90% ^{13}C) and 56 liters of CO_2 (97% ^{13}C) were produced. A 110-liter batch of methane (>97% ^{13}C) and a 100-liter batch of methane (>99% ^{13}C) were produced by thermal diffusion. (LK)

97 (MLM-2168, pp 9-10) STABLE ISOTOPE SEPARATION. 30 Aug 1974.

In Mound Laboratory activities for the Division of Physical Research: January–June 1974.

The following stable isotopes were separated: ^{37}Ar, ^{78}Kr, ^{82}Kr, ^{21}Ne, and ^{124}Xe. (LK)

98 (MLM-2168, pp 11-26) SEPARATION RESEARCH. 30 Aug 1974.

In Mound Laboratory activities for the Division of Physical Research: January–June 1974.

Progress is reported in the following areas of separation research: molecular beam scattering, thermal diffusion factor of $^3He-^4He$, liquid thermal diffusion of sulfur isotopes with carbon disulfide as the working fluid, and calcium isotope separation. (LK)

99 (MLM-2168, pp 27-30) LOW TEMPERATURE RESEARCH. 30 Aug 1974.

In Mound Laboratory activities for the Division of Physical Research: January–June 1974.

New values of the latent heat of vaporization of natural neon (462 ± 2 cal/mole) and ^{20}Ne (461 ± 9 cal/mole) and ^{22}Ne (469 ± 29 cal/mole) were calculated. Preliminary vapor pressure measurements of ortho-para mixtures of D_2 were made. (LK)

100 INTERMEDIATE OXYGEN SPECIES OF HOMOMOLECULAR OXYGEN EXCHANGE AND THE OXIDATION OF CARBON MONOXIDE OVER ZINC OXIDE UNDER ILLUMINATION. Tanaka, K. I.; Miyahara, K. (Hokkaido Univ., Sapporo). J. Phys. Chem.; 78: No. 22, 2303-2304(24 Oct 1974).

Results are presented as to how the oxygen species O_2^-, O^-, and O_3^- are related to the exchange reaction and to the oxidation of CO over illuminated ZnO. No detectable exchange of ^{16}O and ^{18}O was observed in the dark; when the catalyst was exposed to illumination, the isotopic exchange of gas-phase oxygen was conspicuously accelerated. The O_3^- species and neutral adsorbed species if present were found to be inactive in the exchange reaction. It is concluded that both the dissociative mechanism, $O_2^- \rightleftharpoons 2O^-$, and the associative mechanism, $O_2^- + O_2 \rightleftharpoons O_4^-$, including the O_3^- species are unfavorable for the isotopic exchange reaction. Further results suggest that the O_3^- species formed by the reaction of O^- with O_2 over illuminated ZnO is the most plausible intermediate in the exchange reaction. The formation of O^- appears to be the slow step in the photocatalytic oxidation reaction. (JGB)

101 PREPARATION OF B-SIGMA-METALLOCARBORANES BY OXIDATIVE ADDITION. Model Intermediates for Transition Metal Catalyzed Hydrogen–Deuterium Exchange in Boron-Hydrogen Containing Species. Hoel, E. L.; Hawthorne, M. F. (Univ. of California, Los Angeles). J. Amer. Chem. Soc.; 96: No. 21, 6770-6771(16 Oct 1974).

The reaction of $(PPh_3)_3IrCl$ with $1,2\text{-}C_2B_{10}H_{12}$ yielded a complex which seemed to arise from oxidative addition of a carboranyl B–H bond to the metal atom. On the basis of NMR spectral data, a structure was proposed for the complex and the position of substitution on the carborane cage was deduced. Reaction products obtained from the use of $1,2\text{-}C_2H_2B_{10}D_{10}$ confirmed that the substitution position was the B(3,6) sites. The use of a similar complex for catalyzing the hydrogen-deuterium exchange of $1,7\text{-}C_2B_{10}H_{12}$ gave >95 deuteration, which indicates the high catalytic activity of this group of metallocarboranes. (JSR)

102 HYDROGEN ISOTOPE FRACTIONATION BETWEEN GASEOUS AND CONDENSED PYRROLE. Szydlowski, J. (Univ. of Warsaw). Radiochem. Radioanal. Lett.; 18: No. 6, 373-378 (26 Sep 1974).

The fractionation of deuterium between gaseous and condensed (liquid and solid) N-deuterated pyrrole has been theoretically studied. The results obtained and their relation to the molecular structure of condensed pyrrole were discussed. (auth)

103 STUDY OF MOLECULAR EXCHANGE PHENOMENON USING RADIOACTIVE MERCURY VAPORS. Singhal, N. S. (Indian Inst. of Tech., New Delhi). Indian J. Chem.; 12: No. 2, 167-169(Feb 1974).

Molecular exchange phenomenon between the liquid phase and the vapour phase was studied at thermodynamic equilibrium using radioactive mercury vapours. A mathematical formula was derived for the determination of exchange coefficient (σ). The value of the exchange coefficient at 125°C obtained in the present study is 0.026 ± 0.003, which is about the same as reported earlier using radioactive mercury as the liquid phase. The isotopic separation during the molecular exchange process was also investigated and the results indicate that there is no isotopic separation. (auth)

104 TRITIATION OF ORGANIC COMPOUNDS USING TRITIATED WATER. Soman, S. D.; Krishnamoorthy, T. M. (Bhabha Atomic Research Centre, Bombay). Curr. Sci. (India); 43: No. 20, 653-654(20 Oct 1974).

Isotopic exchange between fatty acids and water or carbohydrates and ethanol was used to prepare the labeled compound. Scintillation counting was used to determine the tritium activity in the compound of interest. (MCG)

105 ELECTRONIC INTERACTIONS IN POLYSUBSTITUTED BENZENES AND THEIR NITROGEN-CONTAINING HETEROANALOGS STUDIED BY HYDROGEN ISOTOPIC EXCHANGE METHOD. Tupitsyn, I. F.; Zatsepina, N. N.; Kirova, A. V.; Kaminskii, Yu. L.; Ivanenko, A. G. (State Inst. of Applied Chemistry, Leningrad). Reakts. Sposobnost Org. Soedin., Tartu. Gos. Univ.; 10: No. 1, 143-162(Apr 1973). (In Russian).

The kinetics of the aromatic CH-bonds isotopic exchange for a large series of mono- and polysubstituted benzenes and their nitrogen heteroanalog in $CH_3OH + CH_3OD$ solutions have been studied. The results are listed in Table 1 in the Russian text. The logarithms of rate constants (including additional literature data, see Table 2) have been correlated with characteristic parameters such as σ_I, σ_R^+, σ_R^-. The established multiple correlation [Eq. (2)] shows the importance of the inductive effect; the electromeric resonance effect apparently due to the σ,π-interactions has some significance for the stabilization of the transition state; the mesomeric effect plays only a negligible role in the lgk variations. The fact that the additivity rule of lgk breaks down for some polysubstituted compounds is considered as an evidence of distortions due to the polar conjugation. From the data for several reaction series of isotopic exchange of the aromatic CH-bonds one can conclude that the specific solvation of nitrogen heterocycle by the solvents molecules causes a considerable decrease in the "α-lone pair effect" of heteroatom $\sim N\!=$. (auth)

106 EXCHANGE OF DEUTERIUM WITH HYDROGEN OF THE SURFACE OF ZEOLITE CATALYSTS. II. HNa-Forms of Types X and Y Zeolites. Minachev, Kh. M.; Bremer, G.; Dmitriev, R. V.; Shteinberg, K. G.; Isakov, Ya. I.; Detyuk, A. N. (Inst. of Organic Chemistry, Moscow). Bull. Acad. Sci., USSR, Div. Chem. Sci. (Engl. Transl.); 23: No. 2, 261-265(Feb 1974).

Translated from Izv. Akad. Nauk SSSR, Ser. Khim.; 23: No. 2, 289-294(Feb 1974).

The concentrations and mobilities of hydrogen in decationized zeolites of type X and Y with various residual contents of Na^+ were determined by the method of isotopic exchange with deuterium. The content and mobility of hydrogen are a maximum in the ultrastable type Y zeolite. (auth)

107 OXYGEN ISOTOPE EXCHANGE BETWEEN ILLITE AND WATER AT 22°C. James, A. T. Houston, TX; Rice Univ. (1974). 65p. University Microfilms Order No. 74-21,286.

Thesis (Ph. D.).

Oxygen isotope exchange experiments at 22°C were made on a series of illites displaying a range of perfection of crystallinity and degree of interstratification. Structurally bound oxygen was found to undergo significant nonequilibrium exchange over periods ranging from two to seventy months. Exchange was found to be surface area dependent, apparently occurring predominantly in the basal planes of the silica and alumina tetrahedra. Although reaction kinetics are extremely sluggish, 1000 ln α appears to be in the neighborhood of +22.5 at 22°C for the illite–water system. On the basis of oxygen content and x-ray diffraction characteristics, a conceptual structural model for poorly crystallized, stacking disordered illites is discussed, suggesting that structurally equivalent oxygen sites may possess varying propensities for isotopic exchange. The present study suggests that any illitic material exhibiting the slightest degree of random interstratification may lose its isotopic imprint soon after it is placed in a new aqueous environment. As a result, the oxygen isotopic composition of illites in sedimentary rocks must be interpreted with caution. Additional geologic significance of the results of this study is also discussed. (Diss. Abstr. Int., B)

108 OXYGEN ISOTOPE FRACTIONATION BETWEEN QUARTZ AND K-FELDSPAR AT 600°C. Blattner, P. (Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Inst. of Nuclear Sciences); Bird, G. W. (Victoria

Univ., Wellington (New Zealand). Dept. of Physics). Earth Planet. Sci. Lett.; 23: No. 1, 21-27(Aug 1974).

Quartz and K-feldspar were grown and/or equilibrated in a common fluid at 600°C, and were analyzed mass spectrometrically as pairs. Various errors that could affect quartz-feldspar oxygen isotope temperature calibrations that are derived from quartz-solution and feldspar-solution data of different studies, are thereby avoided. Using a range of starting materials, the result 10^3 ln α(quartz-K-feldspar) = 1,8 ± 0,15 was obtained, a value in reasonable agreement with geological data. (auth)

Feed Materials Processing

Refer also to abstract 827.

Radiation Chemistry

Refer also to abstracts 149, 672, and 1363.

109 (AD-779607) TEMPERATURE OF THERMAL PEAKS DURING IONIC CRYSTAL IRRADIATION. Eremin, L.; Oblivantsev, A. N. Translated from Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 3, 149-150(1971). 5p. NTIS $4.00.

In 5-MeV proton and 20-MeV alpha irradiation of polycrystalline $NaNO_3$ tablets, two radiative dissonance zones with different activation energies were observed with corresponding peak temperatures of 324 and 345°K, respectively. These correspond to $NaNO_2$ decomposition temperatures and differ slightly from room temperature for the irradiation. Energy is distributed in a very short time over a wide area before it is transferred to the lattice. (auth)

110 (AED-CONF-73-187-001) POLAROGRAPHY OF SHORT-LIVED RADICALS AND IONS IN ACETONE. Asmus, K. D.; Graetzel, M. (Hahn-Meitner-Institut fuer Kernforschung Berlin G. m. b. H. (F. R. Germany). Sektor Strahlenchemie). 1973. 2p. (In German). (CONF-7305101-1).

From 72nd general meeting of the Deutsche Bunsengesellschaft fuer Physikalische Chemie; Erlangen, F. R. Germany (31 May 1973).

The reaction of a pulse of high-energy electrons of 20 nsec in acetone produces the short-lived radicals $(CH_3)_2COH$ and CH_2COCH_3, which are studied by polarography. The oxidation proceeds according to $(CH_3)_2COH \rightarrow e^- + H^+ + (CH_3)_2CO$. The lifetimes of the radicals (ca. 5-100 μsec) are shorter in the presence of tetrachloromethane. Short-lived cations of anthracene, naphthalene, benzene, acetone (< 1 μ sec), their reduction and their half-value potentials are discussed. (GE)

111 (AED-CONF-73-430-014) GAMMA-INDUCED RADIATION DAMAGE TO ^{3}H-LABELLED NUCLEIC ACID BASES IN SOLID STATE AND IN AQUEOUS SOLUTION. Merwitz, O. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Physikalische Chemie). 1973. 6p. (In German). (CONF-7309120-1).

From annual meeting of the Deutsche Gesellschaft fuer Biophysik; Juelich, F. R. Germany (27 Sep 1973).

Specifically labelled nucleic acid bases (adenine-2-T, adenine-8-T, guanine-8-T, cytosine-5-T, thymine-(methyl-T), thymine-6-T, uracil-5-T and uracil-6-T) were irradiated with 10^2-10^3 ^{60}Co gamma rays in the solid state under vacuum; only thymine-(methyl-T) has also been irradiated in aqueous solution. Measurement of the labelled hydrogen set free from the solid substances due to irradiation has been carried out in a gas filling counter tube. The dose-effect curves describing the splitting off of hydrogen from the various positions of the bases showed a sigmoid shape and a clear threshold value. Thus some information was gained for the first time on the position-specific radiation damage to solid bases. The dose-dependent G-values have been calculated and compared. In order to determine the tritium atoms split off from the dissolved thymine (methyl-T), which can be detected as HTO after irradiation, several equal amounts of water have been distilled and measured in a liquid scintillation spectrometer. In this case, linear dose-effect relationships have been found which, in contrast to the solid phase data, showed no threshold value. The amount of tritium atoms split off from the methyl group of the thymine increased with increasing concentration of the dissolved substance so that different, dose-independent G-values have been obtained, depending on the molarity of the solution. The mechanisms underlying the sigmoid-shaped and the linear dose-effect relationships, the influence of impurities on the course of the curves and the biological relevance of the results obtained are discussed. (GE)

112 (ANL-8096, pp 65-79) RADIATION CHEMISTRY AND PHOTOCHEMISTRY. Apr 1974.

In Chemistry Division annual report, July 1972-June 1973.

Progress is reported in the on-line processing of data gathered using the fast-photodiode and sampling-oscilloscope combination. Current research on stroboscopic pulse radiolysis systems is described. Results of pulse radiolysis studies on N_2O-saturated solutions of K_2PtBr_4 and K_2PtBr_6 are reported. Certain transients were identified and the kinetics of their formation and decay studied. In studies on the fluorescence from UO_2^{2+} in tritiated water, no evidence for an emission plateau was found when the UO_2SO_4 concentration was extended from 0.2 to 1.5M. Ethane and higher hydrocarbon yields in the γ radiolysis of methane in aqueous solution containing N_2O are tabulated. A possible mechanism for the reaction is proposed. Competition equations were developed from polymer solution theory and probability theory in studies on reactions of OH radicals with polyethylene oxide. In studies on reactions of electrons trapped in 6M NaOH aqueous glass, a suggestion is made to explain the behavior of weak electron acceptors. The reaction of Cl atoms with O_2 to form ClO was studied in further detail, using Cl atoms produced by irradiating CCl_4 or CF_3Cl with 30-nsec pulses of 2 MeV electrons. Competition studies of Cl with NO_2 and Cl with C_2H_4 were undertaken as an aid to establishing the mechanism. Performance tests were made on the Argonne condensation-nucleus discriminator. In studies on monodisperse aerosols, condensation nuclei were generated by bubbling filtered air through NaCl and H_2SO_4 solutions. Concentrations of condensation nuclei from natural waters are tabulated. Results of studies on the mechanisms of formation of photosolvation products of benzene are reported. (JGB)

113 (KFK-1969-UF) INVESTIGATIONS ON WATER AND WASTE WATER CHEMISTRY 1972/1973. Blangetti, M.; Donnert, D.; Eberle, S. H. (Kernforschungszentrum Karlsruhe (F. R. Germany)). Jun 1974. 124p. (In German). Dep. NTIS (US Sales Only) $9.25.

Reports on investigations in the field of water pollution chemistry done during 1972 and 1973 are presented. The topics included are: accumulation of water pollutants in the adipose tissue as criterion of their hygienic importance, mineral oils in the lake Constance, organic chlorinated compounds on activated carbon filters of water works, profiles of the organic pollution of the Rhine, organic acids in the Rhine and its tributary rivers, analytic characterization of ligninsulfonic acid from water, extractive regeneration of organic loaded activated carbon, and radiation treatment of industrial waste waters. (auth)

114 ELECTRON SPIN RESONANCE STUDIES OF RADICALS IN IRRADIATED ACETATES. Schoening, R. C. East Lansing, MI; Michigan State Univ. (1974). 155p. University Microfilms Order No. 74-19,870.

Thesis (Ph. D.).

Electron spin resonance studies of radicals produced in irradiated single crystals of sodium acetate were carried out. In $CH_3COONa \cdot 3D_2O$ crystals three radicals are formed; the methyl radical predominates at 77°K, the $\cdot CH_2COO^-$ radical becomes the dominant species at 198°K, and at room temperature the $\cdot CO_2^-$ radical is found. The ESR parameters for each radical were determined. In addition, $\cdot CD_3$ was studied in irradiated single crystals of $CD_3COONa \cdot 3D_2O$ at 77°K. Both the $\cdot CH_3$ and $\cdot CD_3$ radicals are π-electron radicals undergoing rotation about their threefold axes at 77°K. Changes in relative intensities of the lines of the spectra on cooling to 4.2°K indicate some restriction of rotation at low temperatures. Anhydrous sodium acetate single crystals produce only $\cdot CH_2COO^-$ radicals at 77°K. In addition, a triplet spectrum was observed, which was attributed to a radical pair with approximately 5.77 Å distance between the two unpaired electrons. Although the components of the pair appeared to be different the spectra did not permit their positive identification. The electron spin resonance spectra of radicals produced in irradiated fluorine-substituted ammonium acetates were also studied. Irradiation of single crystals of ammonium monofluoroacetate produced $\cdot CH_2COO^-$ and $\cdot CFHCOO^-$ in the approximate ratio of 4:1. On warming to room temperature only $\cdot CFHCOO^-$ was present. This room-temperature radical was found to occupy two magnetically inequivalent sites. On cooling, two $\cdot CFHCOO^-$ radicals were observed each with different A(F) and A(H) tensors and each occupying two magnetically distinct sites. The g, and the fluorine and the hydrogen hyperfine splitting tensors, were evaluated for both radicals at −140°C and for the radical at room temperature. In addition, the ^{13}C hyperfine interaction tensor was also obtained for the room-temperature radical. An oscillation of the CHF group of the $\cdot CFHCOO^-$ radical about the C−C bond was postulated to account for the dependence of the ESR spectra on temperature. However, changes in crystal structure may also occur. Irradiated single crystals of ammonium difluoroacetate produced two radicals, $\cdot CFHCOO^-$ and $\cdot CF_2COO^-$, in approximately equal propor-

tions at room temperature. Measurements of the maximum components of the ^{13}C hyperfine splitting tensors gave estimates of the isotropic components. The $\cdot CFHCOO^-$ radical was found to be planar, while the $\cdot CF_2COO^-$ radical is bent approximately 8° from a planar structure. At 77°K, relatively low concentrations of $\cdot CF_2H$ are believed present in addition to more abundant $\cdot CFHCOO^-$ and possibly a third radical. A maximum fluorine coupling of 211 G was assigned to the A_{zz}-(F) principal component of $\cdot CF_2H$ by analysis of the powder spectrum. The $\cdot CF_3$ radical has been tentatively identified as probably arising from irradiation of CF_3COOND_4. A long-range coupling of 14.7 G from a neighboring atom was not eliminated in the deuterated salt as would be expected from a previous assignment of the radical to $[CF_2COOH \cdot NH_3]^-$. Single crystals of ammonium chlorodifluoroacetate were irradiated, and the ESR spectra observed, at 77°K. These show the presence of at least two radicals, one showing chlorine and fluorine hyperfine splitting and the second fluorine hyperfine splitting only. The radicals were assigned the structures $\cdot CF_2-Cl$ and $\cdot CF_2COO^-$. (Diss. Abstr. Int., B)

115 RADICAL PAIRS, ELECTRON SPIN RESONANCE RELAXATION TIMES, AND LIMITING RADICAL CONCENTRATIONS IN γ-IRRADIATED 3-METHYLPENTANE GLASS. Lin, D. P.; Willard, J. E. (Univ. of Wisconsin, Madison). Contract AT(11-1)-1715. J. Phys. Chem.; 78: No. 22, 2233-2236(24 Oct 1974).

New evidence related to the spatial distribution and limiting concentration of 3-methylpentyl radicals in γ-irradiated 3-methylpentane glass at 77°K is presented. An ESR signal at g = 4 attributable to the $\Delta M_s = 2$ transition of radical pairs was observed. The steady-state concentration of isolated radicals at a dose rate of 3×10^{18} eV g^{-1} min^{-1} is ca. 0.4 mole % at 77°K, and is reached after a dose of ca. 2×10^{21} eV g^{-1}. The apparent value of the ESR relaxation time, $(T_1T_2)^{1/2}$, is nearly constant with dose to 1×10^{21} eV g^{-1} or higher, implying small intrinsic spur sizes. Previous evidence on radical pairs in polycrystalline hexadecane was confirmed and extended. (auth)

116 RADIOLYSIS OF 1,1-DIFLUOROETHANE. Carmichael, H.; Lau, Y. K. (North Carolina State Univ., Raleigh). J. Phys. Chem.; 78: No. 22, 2183-2186(24 Oct 1974).

1,1-Difluoroethane was irradiated in the gas phase both in the presence and absence of NO, and those products eluting from a Porapak Q column before 1,1-difluoroethane were identified and measured. Hydrogen is formed by at least two processes. Trifluoromethane and 1,1,1-trifluoroethane are formed by fluoride ion transfer reactions of fragment ions. Methane and ethane are formed from methyl radicals resulting from fragmentation of the parent ion. Ethene, fluoroethene, and 1,1-difluoroethene are all formed in significant amounts. In the absence of radical scavengers all unsaturated products reach limiting concentrations of less than 100 ppM. (auth)

117 RADIATION-INDUCED BONDING OF IODINE AT THE SURFACE OF UNIFORM POLYSTYRENE PARTICLES. Huh, Y.; Donaldson, G. W.; Johnston, F. J. (Univ. of Georgia, Athens). Radiat. Res.; 60: No. 1, 42-53(Oct 1974).

Uniform polystyrene particles in aqueous suspensions were subjected to ionizing radiation from ^{60}Co. Particles of 0.234-μm diameter were most extensively studied. The suspensions are stable with regard to coagulation and the particles undergo no detectable configurational change up to doses of at least 5×10^{20} eV ml^{-1} of suspension. When irradiated in the presence of iodide, a chemical bonding of iodine to the surface occurs, presumably through the formation of C-I bonds. At a population 1.4×10^{12} particles of 0.234-μm diameter cc^{-1}, the yield of surface-bonded halogen in 5×10^{-4} M iodide corresponds to 0.02 iodine atoms bonded to the particle surface per 100 eV of total energy absorbed. In 5×10^{-4} M iodide, the reaction rate is proportional to the surface area and depends upon the first power of the radiation intensity. The experimental results are consistent with a reaction mechanism in which radical sites are produced on the particle surface by reaction of OH and other radicals from the bulk phase. A surface bonding of iodine results from a reaction of these sites with halogen intermediates formed in the aqueous phase, predominantly by reaction of OH radicals with iodide. Energy absorbed in the particle apparently plays no major role in the reaction, and a complex dependence of the reaction upon the iodide concentration suggests that a surface adsorption of halogen intermediates plays an important role in the reaction. (auth)

118 RADIATION CHEMICAL STUDIES WITH 3.9 GeV N^{7+} IONS. Appleby, A.; Christman, E. A. (Rutgers-The State Univ., New Brunswick, NJ). Radiat. Res.; 60: No. 1, 34-41 (Oct 1974).

Relative radiation-chemical yields were measured in the plateau and Bragg peak region of 3.9-GeV N^{7+} ions for two chemical systems, air-saturated and O_2-free ferrous sulfate systems. In aerated ferrous sulfate solution, there is a markedly greater effect of solute concentration in the plateau than in the peak. In both systems, chemical yields in the plateau are similar to those from helion or deuteron-irradiated solutions of lower LET. Both these effects are attributed to track-core expansion in the plateau region as compared to the peak region, brought about by the greater ion velocity in the former, as predicted by the Mozumder model for heavy ion tracks. (auth)

119 RADIOINDUCED FREE RADICALS IN FROZEN SOLUTIONS OF 5-METHYLCYTOSINE. Lion, Y.; van der Vorst, A. (Univ., Liege). Int. J. Radiat. Biol.; 25: No. 5, 525-529(May 1974). (In French).

The free radicals produced by x-radiolysis at 77°K of alkaline solutions (NaOH and NaOD, 2N and 8N) and aqueous solutions (H_2O and D_2O) of 5-methylcytosine were qualitatively identified by studies of the ESR spectra. The presence of radicals ($RH_2^\cdot$), rather than ($RD_2^\cdot$), after radiolysis in a matrix of D_2O is explained by the protonation of (RH^-) radicals by protons derived from the base itself rather than the D_2O. This result indicates that the mechanisms of the radiolysis of each of the constituent bases of the nucleic acids should be analyzed individually. (UK)

120 EFFECTS OF IONIZING RADIATION ON BOUNDARY SURFACES. Cyclic Changes of the Electrophoretic Properties of Albumin and Quartz After Irradiation with Small Doses of X Radiation. Tribukait, B. (Karolinska Mediko-Kirurgiska Institutet, Stockholm). Acta Radiol., Suppl.; No. 310, 221-234 (1971). (In German).

Cyclic changes of the electrophoretic mobility of quartz and albumin after irradiation with roentgen doses up to 200 R are described. The electrophoretic mobility of quartz was estimated by direct microscopic observation in a micro-electrophoretic system, that of albumin after adsorption on quartz. The influence of the pH of the surrounding buffers and of oxygen as compared with nitrogen during irradiation of albumin was investigated. When using an acidic environment, where the molecular charges are positive and irradiation results in the formation of other types of radicals, cyclic changes are found similar to those produced in neutral or weakly basic environments. Oxygen, however, considerably changes both the frequency and the amplitude of the variations. If albumin and quartz are irradiated together, the changes in the mobility are altered considerably compared with irradiation of either of them individually. After irradiation of dry albumin substance systematic cyclic changes also occur in the mobility with increasing doses. The similarity in the changes of the electrophoretic mobility of the irradiated quartz and of irradiated erythrocytes are discussed. The results suggest the influence of both direct and indirect irradiation effects. (auth)

121 RADIOCHEMICAL TRANSFORMATION OF ADAMANTANE. Zedelashvili, E. N.; Shanshiashvili, M. I.; Ershov, B. G. (Inst. of Physical and Organic Chemistry, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 75: No. 3, 605-608(Sep 1974). (In Russian).

The radiochemical transformation of crystalline adamantane was investigated in an oxygen-free medium. On the basis of the determination of the nature of the end-products of radiolysis the mechanism of the radiochemical transformation of adamantane is presented. (auth)

122 CONTRIBUTION TO THE RADIATION PREPARATION OF WOOD-PLASTIC MATERIALS. VI. Use of Emulsion Polymerization in the Preparation of Wood-Plastic Combinations (WPC). Varga, S.; Piatrik, M. (Slovak Technical Univ., Bratislava). Radiochem. Radioanal. Lett.; 19: No. 2, 135-140(20 Oct 1974).

The possibility of the use of emulsion polymerization in the preparation of WPC by the radiation polymerization technology was examined. The choice of the suitable detergent was made; the influence of the composition of emulsion and of the concentration of detergent on the rate of radiation polymerization reaction was studied. The dependences of the content of polymer on radiation dose for three monomer systems: styrene, styrene-acrylonitrile and styrene-methyl methacrylate were obtained. (auth)

123 RADIOLYSIS OF TRI-n-BUTYL PHOSPHATE IN AQUEOUS SOLUTION. Clay, P. G.; Witort, M. (Imperial Coll. of Science and Tech., London). Radiochem. Radioanal. Lett.; 19: No. 2, 101-107(20 Oct 1974).

In γ-irradiated oxygenated solutions of tri-n-butyl phosphate (TBP) in dilute sulfuric acid (pH 1.2) di-n-butyl phosphate (DBP) is a major product, G = 2.1. In solutions acidified with nitric acid G(DBP) declines with increasing $[HNO_3]$, reaching a value of 0.49 at $[HNO_3] = 4.0M$. This effect is ascribed to competition

between TBP and undissociated HNO_3 for hydroxyl radicals. Other products of the radiolysis include butyraldehyde, and dicarbonyl and carbonyl phosphate compounds. (auth)

124 CONTRIBUTION TO THE RADIATION PREPARATION OF WOOD-PLASTIC MATERIALS. V. Radiation-Induced Polymerization of Styrene and Vinyl Acetate, Styrene, and Vinylidene Chloride or Styrene and Divinylbenzene in Preparation of Wood-Plastic Combination (WPC). Piatrik, M.; Varga, S. (Slovak Technical Univ., Bratislava). Radiochem. Radioanal. Lett.; 19: No. 1, 11-16(13 Oct 1974).

The conditions for the preparation of WPC on the basis of the monomer mixtures: styrene–vinyl acetate, styrene–vinylidene chloride and styrene–divinylbenzene were studied. The influence of the mixture composition on the kinetics of the process of radiation polymerization in wood was also studied. The dependences of the conversions of the mentioned mixtures in wood on absorbed radiation doses were obtained. (auth)

125 GAMMA RADIOLYSIS OF LIQUID n-BUTANE–ISOBUTANE MIXTURES. Horvath, Z.; Foldiak, G. (Inst. of Isotopes, Budapest). Radiochem. Radioanal. Lett.; 19: No. 1, 67-75(13 Oct 1974).

During radiolysis of mixtures of n-butane and isobutane, processes of energy and charge transfer in both directions as well as competing mono- and bimolecular chemical reactions take place. It has been reinforced that it is not correct to speak about "protection" in such systems, since while the rate of some processes decreased that of other ones increased. With varying composition of the mixture, even the direction of the resulting reactions may change in addition to the absolute rate of the overall processes. (auth)

126 CHEMICALLY INDUCED DYNAMIC ELECTRON POLARIZATION. The Isotropic g-Factor Differences and the CIDEP of Radicals Produced by Pulse Radiolysis. Trifunac, A. D.; Avery, E. C. (Argonne National Lab., Ill. (USA)). Chem. Phys. Lett.; 27: No. 1, 141-143(1 Jul 1974).

Time resolved electron paramagnetic resonance spectroscopy was used to examine the electron spin polarization in the $\cdot CH_2OH$ radical. The observation of the CIDEP dependence on the isotropic g-factor differences of the radical pair components leads to the conclusion that the $S-T_0$ mixing of the electron–nuclear states in radical pairs is a dominant polarization pathway. (auth)

127 ^{60}GAMMA RADIATION-INDUCED DEEP CHLORINATION OF HYDROCARBONS. Grinevich, I. A.; Egunov, A. V.; Nikolaev, N. E.; Raichuk, F. Z.; Ryabov, E. A.; Chertorizhskii, A. V. Khim. Prom. (Moscow); No. 10, 11-13(1973). (In Russian).

Radiation-chlorination of toluene, p-xylene, ethylbenzene, and polychloropentanes was carried out with the aim of making benzotrichloride, octachlorocyclopentene (OCHCP), and hexachlorocyclopentadiene as well as products of depleted chlorination of ethylbenzene and p-xylene in the side chain. The reaction rate in all cases was proportional to the 0.5 power of the radiation intensity. Chlorination of alkyl aromatic compounds in the side chain took place at an 0.5 power according to chlorine and 1 according to the organic substance. The activation energy of the reaction of replacement of hydrogen by chlorine in the side chains of toluene and p-xylene increased with increase in the degree of chlorination. Radiation synthesis of OCHCP was shown to occur under milder conditions than in ordinary methods and with high product yield. (tr-auth)

128 RADIATION-CHEMICAL DECOMPOSITION OF LIQUID HEXANES AND HEXANE MIXTURES. II. γ-Radiolysis of Binary Hexane Mixtures. Gyorgy, I.; Foldiak, G. (Inst. of Isotopes, Budapest). Acta Chim. Acad. Sci. Hung.; 81: No. 4, 455-466 (1974).

The radiation-chemical yields of hydrogen and of the C_1-C_4 fragments formed during the γ-irradiation of binary hexane mixtures have been determined as functions of the composition. For most of the mixtures and most of the products, the G-values obtained deviate from the yields calculated on the basis of the additivity rule. The experimental results are interpreted by electronic energy and/or positive charge transfer between the compounds. The transfer processes change the ratio of the steady-state concentrations of the activated molecules, primarily formed in proportion to the electron fractions of the hexanes constituting the mixture. The composition vs. G-value curves suggest that in the transfer process observed the hexane with the higher ionization potential usually behaves as donor, while that with the lower ionization potential, as acceptor. If the ionization potentials are approximately equal, the hexane containing more methyl groups, i.e., the one which, on irradiation, decomposes with a relatively higher hydrocarbon yield, will be the acceptor. The observed phenomena are attributed to an equilibrium between transfer processes and monomolecular decomposition. (auth)

129 RADIATIVE MODIFICATION OF ETHYLENE AND VINYL ACETATE COPOLYMERS. Sirota, A. G.; Zaytseva, N. K.; Karkozova, G. F.; Ryabikov, E. P.; Bukhgalter, B. I.; Berlyant, S. M.; Gladigau, G. Plast. Massy; No. 2, 22-24(1974). (In Russian).

A study was made of the mechanisms and properties of radiative ethylene vinyl acetate copolymer cross-links in copolymers containing vinyl acetate to 25%. Cross-link density was characterized by gel fraction content and index of melt of the irradiated samples. In comparison to polyethylene, ethylene vinyl acetate cross-linking proceeds more effectively. For all vinyl acetate concentrations lower initial melt indices correspond to greater relative decrease in melt index. These cross-linkings can be accomplished at relatively low doses from 0.5 to 1.5 Mrad. This process increases the limits of stability to stretching and the relative elongation on breaking. However the maximal value of the stability is achieved at a lower dose than for polyethylene. Irradiation up to 0.2 to 0.8 Mrad increases the critical rate of viscous flow and improves the form stability of exudates, while higher doses decrease them. The copolymer cross-links facilitate an extension of the processing temperature interval from 90 to 115°C. (JPRS)

130 RADIATION-INDUCED POLYMERIZATION OF METHYL METHACRYLATE. Liu, Y. M. Hua Hseuh Tung Pao; No. 3, 37-39; 64(23 May 1974). (In Russian).

Experiments on radioinduced polymerization of methyl methacrylate are discussed. The methyl methacrylate monomers used in the experiments were used to produce organic glass monomers for the Shanghai Shan-hu Chemical Plant. The peroxide concentration (N) in gram molecules per liter produced by irradiation is a function of radiation dosage (D), radiation intensity (I), and radiation temperature (T) and may be expressed $N = f(D,I,T)$. The empirical formula is $N = 1.29 \times 10^{-7}\ I^{0.5}\ D\ (I/295)\ 16.3$. The useful range of the formula is T: 10 to 70°C, D: 4×10^4 to 1.44×10^6 roentgens, and I: 20 to 170 roentgens per second. Since the activation energy is low, polymerization may occur at low temperatures and the dynamic processes are comparatively stable. Organic glass over 200 millimeters thick was obtained experimentally. (JPRS)

131 RADIATION-MODIFIED POLYMERIC AEROGELS. Babkin, I. Yu.; Kitaev, K. N. (Scientific-Research Physical-Chemical Inst., Moscow). Vysokomol. Soedin., Ser. B; 16: No. 6, 420-422(Jun 1974). (In Russian).

Use is made of polystyrene with a mol. wt. of 800,000, and of poly(methyl methacrylate) with a mol. wt. of 480,000 and 150,000. The polymers were purified by reprecipitation from solution. Sublimation of a benzene solution of the polymer was carried out in a thermostated chamber at –12°C from copper dishes. The completeness of solvent separation was estimated from the constancy in weight. Aerogel structure studies were carried out by optical and electron microscopy. The aerogels were modified by gas-phase, graft copolymerization of acrylonitrile with the use of ^{60}Co gamma irradiation at a relative acrylonitrile vapor pressure of 0.3. Electron microscopic studies show a typical microfibrous aerogel structure at a polymer concentration of 0.01 to 0.02% and a freezing temperature of –12°C. At lower polymer concentrations (0.001 to 0.002%) along with the fibers, as a rule, many spherical formations are observed. An increase of polymer concentration to 0.1 to 0.2% leads to a planar aerogel structure. Acrylonitrile grafting imparts heat resistance to heightened temperature. These structures can be used in filtering materials or highly porous adsorbents. (SJR)

132 KINETICS OF THE DECAY OF CHARGES IN IRRADIATED RUBBER UNDER THE ACTION OF LIGHT. Bol'shakova, S. I.; Kuz'minskii, A. S. Vysokomol. Soedin., Ser. A; 16: No. 7, 1509-1515(Jul 1974). (In Russian).

A study was made of the kinetic properties of charged particles captured by a copolymer of butadiene with acrylonitrile irradiated at 77°K with and without additions of electron donors and acceptors. The kinetics of charge decay under the action of light with a subsequent lowering of wave length has a "step" character. The charge recombination process caused by light with $\lambda > 700$ mm in rubber without addition and with addition of phenyl-beta-napthylamine consists of two stages (fast and slow), and in rubber with the addition of tetrachloroquinone (chloranil) this process takes place in a single stage. The kinetics of charge recombination in both stages of the process are formally described by an equation for a first-order reaction. The rate constant for charge decay is decreased in the presence of additives both of electron donors and acceptors, and with increasing dose of gamma irradiation. With photorecombination of the charges there is a competition in the formation of radicals and the formation of molecular products. The efficiency of the charge annihilation process on the visible light intensity is described. An increase in the visible light intensity leads to an additional drop in concentration of paramagnetic centers. (SJR)

133 RADIATION, LOW-TEMPERATURE POLYMERIZATION OF VINYL CHLORIDE IN GLASSY PARAFFIN MATRICES. Gerasimov, G. N.; Smirnov, A. D.; Sabirova, T. M.; Abkin, A. D. (Scientific-Research Physical-Chemical Inst., Moscow). Vysokomol. Soedin., Ser. A; 16: No. 7, 1530-1535(Jul 1974). (In Russian).

Energy losses were measured during oscillations of an ultrasonic piezoelectric emitter in glasses formed from vaseline (V) and a mixture of vaseline and vinyl chloride (VVC). It is shown that under the action of gamma radiation the VVC polymerizes at -196°C in a vaseline matrix (long-chain paraffins). Polymerization does not take place in a glass of low-molecular-weight paraffins. The velocity of sound was investigated as a function of the temperature of liquid vaseline and of a mixture of vaseline and vinyl chloride (VVC). It was found that these liquids in contrast to low-molecular-weight liquid hydrocarbons have a microheterogeneous structure, and consist of ordered elements in a nonordered medium. An increase of monomer content in a matrix of long-chain paraffins leads to disruption of the ordered elements of the matrix. On the basis of the data a scheme is proposed for the radiation polymerization of vinyl chloride in paraffin matrices, according to which the growth of polymeric chains takes place in a region of extended glass defects on the boundary between the ordered elements (of a block type) and the nonordered medium. Movement of monomer molecules in the region of these defects is oriented, and is determined by the direction of the paraffin block chains. This behavior creates particularly favorable conditions for the growth of polymeric chains. (SJR)

134 STUDY OF THE EFFECT OF GAMMA RADIATION ON A NUMBER OF THE PROPERTIES OF POLY[2,5(4',4"-DIPHENYLENEPHTHALIDE)-1,3,4-OXADIAZOLE] (PDPPO). Korshak, V. V. Rode, V. V.; Lyashevich, V. V.; Pavlova, S. A.; Timofeeva, G. I.; Tur, D. R. Vysokomol. Soedin., Ser. A; 16: No. 7, 1555-1561(Jul 1974). (In Russian).

A study was made of the change in properties of PDPPO during gamma irradiation in air. It was noted that gamma irradiation led to a decrease in molecular weight, film rupture strength and softening temperature of the polymer. On the basis of an analysis of the experimental data it was established that along with destruction a partial branching of the polymer macromolecule took place. (SJR)

135 RADIATION POLYMERIZATION OF MALEIC ACID IMIDE (MAI) AND N-PHENYL-MALEIC ACID IMIDE (PMAI) WITH NONPOLYMERIZING COMPONENTS IN BINARY EUTECTIC SYSTEMS. Petrukhno, L. A.; Ivanov, V. S. (Leningrad State Univ.). Vysokomol. Soedin., Ser. A; 16: No. 7, 1469-1478(Jul 1974). (In Russian).

A study was made of the effect of various additives forming eutectic mixtures with monomers on the radiation, solid-phase polymerization of MAI and PMAI. An increase in the number of structural defects in monomer crystals by the introduction of noncrystallizing additives or by rapid cooling of the melt leads to a significant increase in the rate of solid-phase polymerization. The slowing-down effect of benzoquinone on the solid-phase polymerization of maleic acid imides (MAI and PMAI) as a result of comparison with the effect of succinimide and aromatic additives, which do not belong to typical radical inhibitors, was interpreted in favor of a radical mechanism of polymerization of these monomers in the solid phase. Features of polymerization in two-phase systems are noted. It was established that the rate of polymerization in such systems increases in the presence of monomer crystals. (SJR)

136 INFRARED SPECTROSCOPIC STUDY OF THE LOW-TEMPERATURE RADIATION POLYMERIZATION OF ADSORBED ISOBUTYLENE. Bogdanov, A. P.; Shamonina, N. F.; Sukhov, F. F.; Kotov, A. G. (Scientific-Research Physical-Chemical Inst., Moscow). Vysokomol. Soedin., Ser. B; 16: No. 8, 594-598(Aug 1974). (In Russian).

The adsorption of isobutylene on silica gel and NaY zeolite was examined. The IR spectra of isobutylene adsorbed on these sorbents and irradiated with γ radiation at 77°K was also determined. The spectra of the adsorbed isobutylene indicated radiation-induced polymerization of the monomer. (JSR)

137 CHEMICAL TRANSFORMATIONS OF THE COPOLYMER OF TETRAFLUOROETHYLENE WITH ETHYLENE DURING RADIOLYSIS IN VACUUM. Bol'shakova, N. I.; Tikhomirova, N. S.; Serenkov, V. I.; Zalkind, G. I.; Pridatchina, N. N. Vysokomol. Soedin., Ser. A; 16: No. 8, 1913-1918(Aug 1974). (In Russian).

Infrared studies of the gamma-irradiated copolymer of tetrafluoroethylene with ethylene (1:1) showed changes in chemical structure which depend on the irradiation conditions. With increasing radiation dose there are decreases in absorption band intensities in the region of 1450 and 2773 cm^{-1} corresponding to oscillations of CH_2 groups, and in the series of absorption bands lying in the region of 500 to 1300 cm^{-1} corresponding to valence and deformation oscillations of C-F-bands in CF_2 groups. These changes are more noticeable on increasing the irradiation temperature from 25 to 250°C. The appearance of a different type of double bond is observed: $-CH=CF-$, $-CF=CF-$, $-CH=CF_2$ (bands 1720, 1740 and 1765 cm^{-1} respectively). The change in the intensity of the absorption band in the region of 1740 cm^{-1} is shown as a function of dose and irradiation temperature. With increasing irradiation dose (25°C) there is an increase in the intensity of the 1860 cm^{-1} band referred to the "terminal unsaturation" of $-CF=CF_2$. However at irradiation temperature of 250°C this band vanishes. At increased irradiation temperatures (150°, 250°C) the appearance of a wide absorption band is observed in the region of 1600 to 1700 cm^{-1}, which is associated with the formation of double bonds of the type $-CH=CH_2$ or $-CH=CH-$. On the basis of the data a reaction mechanism is proposed for the destruction and reconstruction taking place during irradiation of the copolymer. (SJR)

138 DETERMINATION OF PRODUCTS OF RADIATION INDUCED OXIDATION OF PYRIDINE IN AQUEOUS SOLUTION. Kostromin, N. P.; Saraeva, V. V. Vestn. Mosk. Univ., Ser. II. Khim.; 15: No. 4, 472-474(1974). (In Russian).

The radioinduced oxidation of pyridine in alkaline and acid aqueous solutions was studied in continuous oxygen flow. Ultraviolet spectroscopy, paper chromatography, and Al_2O_3 adsorption chromatography were utilized for detection of hydroxypyridines. Three compounds, 2-, 3-, and 4-hydroxypyridines, were identified in weakly alkaline solution; the two last compounds were also identified in acid solution. (auth)

139 GAS CHROMATOGRAPHIC DETERMINATION OF GAMMA RADIOLYSIS OF TRIBUTYL PHOSPHATE. Su, C. S.; Wang, J. T. (Inst. of Nuclear Energy Research, Lung-Tan, Taiwan). Nucl. Sci. J. (Taiwan); 11: No. 2, 100-104(Jun 1974).

Trimethyl phosphate (TMP), dimethylbutyl phosphate (DMBP), dibutyl methyl phosphate (DBMP), and tributyl phosphate (TBP) were determined quantitatively by means of gas chromatography. An FID and a 10 ft × 1/8 in. stainless steel column, containing 60/80 mesh Chromosorb W (AW DMCS) coated with 15 wt% Carbowax 20 M, were used in this chromatograph. Samples were first irradiated in ^{60}Co gamma source and then methylation of the degradation products was carried out by the use of diazomethane. (auth)

140 RADIATION-CHEMICAL SYNTHESIS OF AMINO ACIDS FROM MIXTURES OF THE GASES CO_2, NH_3, AND CH_4 IN THE PRESENCE OF SILICA GEL. Kartel, N. T.; Strelko, V. V. (Inst. of Physical Chemistry, Kiev). Teor. Eksp. Khim.; 10: No. 4, 556-558(1974). (In Russian).

The process of the radiation-chemical synthesis of amino acids from γ-irradiated equimolar mixtures of CO_2, NH_3, and CH_4 in the presence of silica gel (S = 600 m^2/g) was studied at γ doses from 1 to 200 Mrad. The formation of 13 amino acids was established by electrophoresis and paper chromatography methods and with an amino acid analyzer. It was shown that in the presence of silica gel the radiation-chemical yield was substantially increased. It was also observed that the state of the surface of the adsorbent affects both the selectivity of the synthesis process of the individual amino acids and their total yield. (tr-auth)

141 KINETICS OF THE LOW-TEMPERATURE REACTION R (RADICAL) + O_2 = RO_2 (RADICAL) IN SOLID POLYSTYRENE AND CUMENE. Yakimchenko, O. E.; Gaponova, I. S.; Gol'dberg, V. M.; Parfiskii, G. B.; Toptygin, D. Ya.; Lebedev, Ya. S. (Inst. of Chemical Physics, Moscow). Bull. Acad. Sci., USSR, Div. Chem. Sci. (Engl. Transl.); 23: No. 2, 321-325(Feb 1974).

Translated from Izv. Akad. Nauk SSSR, Ser. Khim.; 23: No. 2, 354-359(Feb 1974).

The kinetics of the low-temperature reaction $R^{\cdot} + O_2 = RO_2^{\cdot}$ in polystyrene and a glass of its low-temperature analog, cumene, was studied. The limiting step is the migration of dissolved oxygen molecules. The reaction kinetics depends substantially on the inhomogeneity of the matrix. A method is proposed for the determination of the solubility of oxygen, not requiring large quantities of the substance and suitable for various types of samples (films, powders, fibers, etc.). The solubility of oxygen depends substantially on the structure of the sample and influences the rate of oxidation. (auth)

142 NATURE AND MECHANISM OF THE FORMATION OF PARAMAGNETIC CENTERS IN UV-IRRADIATED PROTEINS. Sud'bina, E. I.; Azisova, O. A. (Inst. of Biological Physics, Pushchino, USSR). Biofizika; 8: No. 6, 998-1003(Nov 1973). (In Russian).

Changes induced in protein radicals by 297- and 248-mμ radiation at -196°C were studied. When light was absorbed by aromatic amino acid residues in proteins, radicals formed on the parts of the protein molecules that did not directly absorb the 297-mμ radiation, the peptide group and the S-containing amino acid residues.

The peptide radicals form as a result of addition of an electron to the CO group. The radical breaks down under the action of 365-mμ radiation with rupture of the C–N bond. The 248-mμ radiation caused formation of RS· radicals. The mechanism of radical formation and conversion is discussed. (tr-auth)

143 STUDIES ON THE LIPOIC ACID FREE RADICAL. Chan, W. A. (State Univ. of New York, Brooklyn); Chan, P. C.; Bielski, B. H. J. Biochim. Biophys. Acta; 338: No. 1, 213-223 (25 Jan 1974).

When dihydrolipoic acid is irradiated by ^{60}Co gamma rays at pH 8.0 and in the presence of N_2O, it is converted to lipoic acid with a G value of 3.3 ± 0.3, where G is the number of molecules formed per 100 eV energy absorbed. No other products were detectable. The radiation product was identified by its absorption spectrum and thin-layer chromatography. The lipoic acid free radical was studied with pulse radiolysis. Its absorption spectrum has a maximum at 410 nm with a molar extinction coefficient of 7760 M^{-1} cm^{-1}. The radicals derived from either oxidation of dihydrolipoic acid or reduction of lipoic acid are the same. At pH = 8 the radical decays by second order, $k = (7.45 \pm 0.22) \cdot 10^7$ $M^{-1} \cdot s^{-1}$. Ionic strength studies indicate that the radical decay is influenced by a charge of one. The formation of the lipoic acid radical by pulse radiolysis and the rate of its decay are independent of the concentration of dihydrolipoic acid in the solution, which excludes the possibility of an interaction between the radical and its parent compound to form a complex. The lipoic acid radical reduces FAD to form FADH· at a rate of $k = (2.40 \pm 0.18) \times 10^8$ $M^{-1} \cdot s^{-1}$. (NL)

144 GAMMA RADIOLYSIS OF MONOGERMANE IN THE GAS PHASE. Foster, A. G. Hattiesburg, MI; Univ. of Southern Mississippi (1973). 141p. University Microfilms Order No. 74-3929.

Thesis (Ph. D.).

The gamma induced decomposition of monogermane in the gas phase has been investigated and the principal products were found to be hydrogen, digermane, and trigermane. Between 31 to 161 torr of monogermane, the G values for the production of hydrogen and digermane were pressure independent, having values of 19.9 and 5.0, respectively, at 0.0°C for a 17.5 minute radiolysis. Under these conditions, the G value for the disappearance of monogermane has been calculated to be 26.0 and the appearance of polymer (a surface species of unknown character) calculated to be G(polymer) = 13.2. Plots of G (products) versus time of radiolysis exhibit an oscillatory behavior indicating a complex equilibria of competing reactions for the production of products with a back reaction yielding monogermane or polymer. Investigation of the product yields from the radiolysis of monogermane at different temperatures and in the presence of small amounts of hydrogen, digermane or trigermane substantiate this oscillatory phenomenon. Analysis of the $H_2 : HD : D_2$ product ratios obtained from the radiolysis of a $1.1 : 1.0 :: GeH_4 : GeD_4$ mixture, together with ethylene scavenger studies suggest the contribution to the total mechanism from ion-molecule, free-radical and molecular detachment processes to be 58%, 30% and 12%, respectively, at 17.5 minutes of radiolysis at 0.0°C. (Diss. Abstr. Int., B)

145 INTERACTIONS AMONG THE LOWER VALENCE STATES OF THE OH RADICAL. Smith, W. H.; Elmergreen, B. G.; Brooks, N. H. (Princeton Univ., NJ). J. Chem. Phys.; 61: No. 7, 2793-2799(1 Oct 1974).

In order to define the origins of experimentally observed predissociations within the $A^2\Sigma^+$ state of OH, overlaps of the bound level vibrational wavefunctions in the $A^2\Sigma^+$ state with the vibrational continua of states of OH arising from the ground electronic state separated atoms were computed. Rapid variation of overlap with rotational quantum number occurs for the $a^4\Sigma^-$ and $X^2\Pi_i$ states with the $A^2\Sigma^+$ state. The resulting predissociation widths are compared with the experimental data, and shown to be able to reproduce it by assuming that the $a^4\Sigma^-$ state dominates in the radiationless depopulation of the OH $A^2\Sigma^+$ state. The dependence of the transition moment upon internuclear distance is derived, and compared with previous results. Implications of this analysis in terms of the two body formation of OH are indicated. (auth)

Radiochemistry and Nuclear Chemistry

146 PROCEDURE FOR PREPARING ^3H-LABELED TERTIARY AMINES. Synthesis of [^3H]-6,14-endo-etheno-6,7,8,14-tetrahydrooripavine Derivatives. Lewis, J. W.; Rance, M. J.; Young, G. R. (Reckitt and Colman Pharmaceutical Div., Hull, Eng.). J. Med. Chem.; 17: No. 4, 465-466(Apr 1974).

A tritium label at carbon atoms α and/or β to a tertiary nitrogen was introduced by dehydrogenation to the enamine into which tritium is readily exchanged. The labeled tertiary base is regenerated by subsequent reduction with or without further tritiation. The method was applied to the preparation of [^3H]-6,14-endo-etheno-6,7,8,14-tetrahydrooripavine derivatives with radiochemical purity >98% and high specific activity. (JSR)

Hot-Atom Chemistry

Refer also to abstract 92.

147 CONSECUTIVE UNIMOLECULAR DECOMPOSITION FOLLOWING RECOIL TRITIUM ACTIVATION OF 1,1-DIFLUOROETHANE. Smith, W. S.; Tang, Y. N. (Texas A and M Univ., College Station). Contract AT(40-1)-3898. J. Phys. Chem.; 78: No. 22, 2186-2189(24 Oct 1974).

Excited $C_2H_3TF_2$ formed by T*-for-H substitution in CH_3CHF_2 gives C_2H_2TF and C_2HT as the secondary and tertiary decomposition products, respectively. The observed trends demonstrate that the $C_2H_3TF_2$ yield increases, the C_2HT yield decreases, while the C_2H_2TF yield exhibits a maximum with increasing pressure. These trends are consistent with a mechanism of consecutive unimolecular decomposition in which all the excitation energy is introduced during the initial substitution. (auth)

148 GAS PHASE FLUORINATION OF BENZENE, FLUOROBENZENE, m-DIFLUOROBENZENE, AND TRIFLUOROMETHYLBENZENE BY REACTIONS OF THERMAL FLUORINE-18 ATOMS. Cramer, J. A.; Rowland, F. S. (Univ. of California, Irvine). J. Amer. Chem. Soc.; 96: No. 21, 6579-6584(16 Oct 1974).

Thermal fluorine-18 atoms reacted in the gas phase with benzene, fluorobenzene, m-difluorobenzene, and trifluoromethylbenzene. The ^{18}F atoms were formed at high kinetic energies by the $^{19}F(n,2n)^{18}F$ nuclear reaction and then thermalized by multiple collisions with SF_6. The yields of $^{18}F/H$ are small and pressure independent in the absence of oxygen. With O_2 present, the yields increase substantially, reaching >60% for C_6H_5 ^{18}F from C_6H_6. The yield from substitution of thermal ^{18}F for H ortho to another F substituent is decreased by O_2, while that in meta and para positions is substantially increased. No such diminution of yield in the ortho position is found for CF_3 as a substituent. The substitution of thermal ^{18}F for aromatically bonded F atoms is observed in low yields only. (auth)

Properties of Radioactive Materials

Refer also to abstracts 65, 81, 83, 104, 899, 944, 1023, 1057, and 2227.

149 (ANL-8096) CHEMISTRY DIVISION ANNUAL REPORT, JULY 1972–JUNE 1973. Peppard, D. F. (ed.). (Argonne National Lab., Ill. (USA)). Apr 1974. Contract W-31-109-eng-38. 176p. Dep. NTIS $7.60.

Each of the 23 sections has been abstracted and indexed for NSA. A list of publications and an author index are included. (JGB)

For abstracts of individual sections see: 1, 17, 49, 78, 82, 83, 94, 112, 150–153, 326, 529, 638, 921, 1309, 1593, 1620, 1621, 2168, 2169, and 2579.

150 (ANL-8096, pp 1-7) HEAVY-ELEMENT CHEMISTRY. Apr 1974.

In Chemistry Division annual report, July 1972–June 1973.

Progress in studies of the transcurium elements is reported. In work on fluorine compounds of the actinides, a double salt of Bk and Cs was formed by heating BkF_3 and CsCl in an atmosphere of fluorine. A theoretical analysis of the energy-level structure revealed in the absorption spectrum of Es^{3+} (aquo) was completed. Results of analyses of the absorption spectra of $BkCl_3$ and $CfCl_3$ are reported. Five compounds were formed by hydrothermal reaction of Y_2O_3 with UO_3 over the temperature interval 200 to 360°C. They are: Y_2UO_6, $YUO_2(OH)_3$, $Y_2U_4O_{15}$, $Y_2U_6O_{21}$, and a fifth compound, its composition having not yet been determined. (JGB)

151 (ANL-8096, pp 94-99) HIGH-TEMPERATURE CHEMISTRY. Apr 1974.

In Chemistry Division annual report, July 1972–June 1973.

The thorium–oxygen system was studied by investigating the vaporization behavior of the dioxide phase and univariant system, $Th(l) + ThO_2(s)$. Metastable monoxides of Th and U were prepared and characterized. The melting temperature of the nearly stoichiometric oxide, $Y_2O_{2.990}$, is 2710 ± 10°K, whereas that of $Y_2O_{2.950}$ is 2665 ± 10°K. A thermodynamic characterization of the U_3O_{8-z} phase, having the composition corresponding to oxygen-to-uranium ratios in the range 2.60 to 2.67, from 840 to 1450°K via measured partial pressure of oxygen ranging from 10^{-6} to 1 atm was obtained by a thermogravimetric gas-equilibration method. Thermochemical properties associated with the sublimation of CeF_3, NdF_3, GdF_3,

and TbF_3 were determined through the use of equipment designed to measure, simultaneously, mass-effusion and mass-spectrometric intensities in a molecular beam from a Knudsen effusion cell. Progress in deriving equations of state for nonstoichiometric urania is reported. Results are reported on the correlation of entropy and enthalpy with respect to errors and systematics in the sublimation of lanthanide trifluorides. (JGB)

152 (ANL-8096, pp 100-105) LOW-TEMPERATURE CALORIMETRY. Apr 1974.

In Chemistry Division annual report, July 1972–June 1973.

Progress is reported on studies on the heat capacity, entropy, and other thermodynamic properties of $^{242}PuF_3$ from 10 to 350°K. Heat capacity and other thermodynamic properties of cesium molybdate, Cs_2MoO_4, at 5 to 350°K were studied. Results of a calorimetric study of α-Na_2UO_4 on heat capacity from 5 to 350°K and some derived thermodynamic functions are reported. (JGB)

153 (ANL-8096, pp 122-126) MOLECULAR SPECTROSCOPY. Apr 1974.

In Chemistry Division annual report, July 1972–June 1973.

Five general types of problems were studied in spectroscopic investigations of inorganic and coordination compounds under varying pressures: infrared-active phonon modes in ionic and pseudoionic crystals; the glassy state; vibrational modes in nonaqueous solutions; coordination compounds of lanthanides and actinides; and multicoordinate complexes (coordination number = 4,5,6,12). A resonance Raman study of the uranyl and transuranium V, VI, and VII ions was completed. The ν_1, Raman-active mode was observed for the first time. A normal coordinate treatment of H_3O^+ and D_3O^+ was completed. Laser Raman studies were conducted on some hexafluoride anions, including $NO^+UF_6^-$, $NO^+MoF_6^-$, and $NO^+OsF_6^-$. (JGB)

154 PREPARATION OF RADIOACTIVE KRYPTONATES OF PLASTICS BY KRYPTONATION DURING THE FORMATION OF THE CARRIER SOLID PHASE. Tolgyessy, J.; Harangozo, M.; Dillinger, P.; Varga, S.; Klehr, E. H. (Slovak Technical Univ., Bratislava). Radiochem. Radioanal. Lett.; 19: No. 2, 147-150 (20 Oct 1974).

Monomers such as methyl methacrylate, vinylbenzene, styrene and acrylonitrile were polymerized under specified conditions of time and temperature in an atmosphere containing ^{85}Kr. During polymerization under static or dynamic conditions ^{85}Kr was captured by the polymer and was found to be uniformly distributed in the resulting plastic. (auth)

155 SYNTHESIS OF NEOSTIGMINE BROMIDE (RING-UL-^{14}C). Gellett, C. F.; Vacik, J. P.; Stiver, J. F. (North Dakota State Univ., Fargo). Radiochem. Radioanal. Lett.; 19: No. 2, 109-116(20 Oct 1974).

Neostigmine bromide (Ring-UL-^{14}C) was synthesized by reducing m-nitrophenol (ring-UL-^{14}C) to m-aminophenol (ring-UL-^{14}C) which was methylated using high pressure and high temperatures to obtain m-dimethylaminophenol (ring-UL-^{14}C). This compound was reacted with dimethyl carbamoyl chloride to give the carbamate ester which was reacted with methyl bromide to give the title compound. Radiochemical purity was determined using thin layer chromatography and autoradiography. Specific activity was found using liquid scintillation counting. (auth)

156 REACTIONS OF IODINE-123 ATOMS WITH LIQUID MONOFLUOROBENZENE. Abdel Ghani, A. H.; Vernois, J.; Muxart, R. (Univ., Paris). Radiochem. Radioanal. Lett.; 18: No. 6, 359-364(26 Sep 1974).

The reactions of nucleogenic ^{123}I atoms with liquid monofluorobenzene have been studied. In the absence of scavengers the total organic yield is about 21%; it decreases from 16% to 12% with increasing scavenger concentration from 10^{-4} to 5×10^{-3} mole fraction. The halogen and the hydrogen substitution yields are of the order of 2.5% and 6.5% respectively, and they are not much affected by the presence of scavengers. The results are compared with those obtained in the case of ^{125}I and other nucleogenic halogens. (auth)

157 OCCURRENCE, PREPARATION, PROPERTIES AND USES OF TRANSURANIUM ELEMENTS. Seelmann-Eggebert, W. (Karlsruhe Univ. (TH) (F. R. Germany). Inst. fuer Radiochemie). Fridericiana; No. 13, 49-54(Nov 1973). (In German).

With figs. and tabs.

The occurrence and natural origin, preparation, and properties are reviewed. A sector of the "Karlsruhe Nuclide Chart," the artificial elements (Tc, Pm, Np, to Lr), californium, and the elements beyond californium are also discussed. (GE)

158 SOLUTION CHEMISTRY OF POLONIUM. I. Adsorption of Polonium in Acidic Solution. Suganuma, H.; Samukawa, T.; Hataye, I. (Shizuoka Univ., Japan). Rep. Fac. Sci., Shizuoka Univ.; 8: 51-58(Dec 1973).

The adsorption of polonium was studied by using glass, synthetic resin (Teflon), and platinum as an adsorbent in varying concentration of the different acid solution together with the desorption experiments. Polonium was found to be less adsorbed onto glass in a strongly acidic solution, whereas fairly adsorbed onto Teflon. Adsorption of polonium onto platinum was considerably large. Rate of adsorption was especially considered. (auth)

159 NOTE ON THE CHARACTERISTICS OF BISMUTH URANATES. Gurumurthy, C. V. (Univ. of Tech., Eindhoven, Netherlands). Indian J. Chem.; 12: No. 2, 212-213(Feb 1974).

A method is reported for the preparation of bismuth uranates at low temperatures. Some of the properties of these compounds are critically examined. From the X ray pattern the d-values are computed and an attempt has been made to arrive at the type of the unit cell. (auth)

160 EFFECT OF IMPURITIES ON THE KINETICS OF CRYSTALLIZATION AND DISSOLUTION OF THORIUM OXALATE. Bykhovskii, D. N.; Petrova, I. K. Sov. Radiochem. (Engl. Transl.); 16: No. 1, 110-112(1974).

Translated from Radiokhimiya; 16: No. 1, 114-116(1974).

A comparative determination of the rates of crystallization and dissolution of thorium oxalate in the presence of Ba^{2+}, Ca^{2+}, Mn^{2+}, Zn^{2+}, Mg^{2+}, K^+, and Ce^{3+} was made. The results were compared with previously published data on the capacity of cations for cocrystallization with thorium oxalate. (LK)

161 COMPOUNDS OF URANOOXALIC AND THOROOXALIC ACIDS WITH BENZYLQUINOLINIUM. Petrzhak, G. I.; V'yugina, A. F.; Karago, L. V. Sov. Radiochem. (Engl. Transl.); 16: No. 1, 118-119(1974).

Translated from Radiokhimiya; 16: No. 1, 120-122(1974)

Compounds of tetravalent uranium and thorium with benzylquinolinium with the composition $(BQ)_4[U(C_2O_4)_4]$, $BHQ[U(C_2O_4)_3]$, and $BQH[Th(C_2O_4)_3]$ were obtained. (auth)

162 ESTIMATION OF OXIDATION POTENTIAL OF AMERICIUM(VI) IN AN ALKALINE MEDIUM. Nikolaevskii, V. B.; Shilov, V. P.; Krot, N. N. Sov. Radiochem. (Engl. Transl.); 16: No. 1, 120-121(1974).

Translated from Radiokhimiya; 16: No. 1, 122-123(1974).

The oxidation potential of Am(VI) was studied by using it to oxidize Np(VI) and Pu(VI) to the heptavalent state. Specially purified ^{237}Np, ^{239}Pu, and ^{241}Am were used. (LK)

163 RADIOCOLLOIDS IN SORPTION SYSTEMS. XI. Nature of Maximum on Anti Epsilon-pH Isotherm. Relation of Sorption and Colloidal Properties of a Radioisotope in the Formation of True Colloids. Betenekov, N. D.; Egorov, Yu. V.; Puzako, V. D. Sov. Radiochem. (Engl. Transl.); 16: No. 1, 17-22(1974).

Translated from Radiokhimiya; 16: No. 1, 20-26(1974).

The physicochemical nature of the maximum on $\bar{\varepsilon}$-pH isotherms for both ionically disperse and true colloidal states of a microcomponent-sorbate was elucidated. We established the limits of applicability of concepts in the literature on the relation of the sorption and colloidal properties of radioisotopes which form true colloids in solution. (auth)

164 COMPLEX COMPOUNDS OF PENTAVALENT AMERICIUM IN SOLUTIONS OF ETHYLENEDIAMINETETRAACETIC AND DIETHYLENETRIAMINEPENTAACETIC ACIDS. Nikolaevskii, V, B.; Shilov, V. P.; Krot, N. N. Sov. Radiochem. (Engl. Transl.); 16: No. 1, 57-61(1974).

Translated from Radiokhimiya; 16: No. 1, 61-66(1974).

It was established by a spectrophotometric method that americium(V) forms only one complex, AmO_2HY^{2-}, with ethylenediaminetetraacetic acid in solutions with pH = 2.5-7. Under the same conditions AmO_2^+ ions give with diethylenetriaminepentaacetic acid two complex anions with the composition $AmO_2H_2Z^{2-}$ and AmO_2HZ^{3-}. The concentration stability constants of these complexes were determined at 25°C with an ionic strength of 0.1. (auth)

165 REACTION OF NEUTRAL COMPLEXES OF URANYL WITH STANNIC CHLORIDE. Vdovenko, V. M.; Kovaleva, T. V.; Kanevskaya, N. A.; Suglobov, D. N. Sov. Radiochem. (Engl. Transl.); 16: No. 1, 62-65(1974).

Translated from Radiokhimiya; 16: No. 1, 66-70(1974).

In the interaction of excess $SnCl_4$ and complexes of uranyl salts with TOPO in benzene and CCl_4 only in the case of fluoride complexes is there separation of the neutral salt, UO_2F_2, from the solution. The chloride, acetate, and nitrate complexes form complex compounds in which it is very probable that there are bridging acido ligands connecting the U and Sn. A large number of intermediate compounds were detected in solution through the IR spectra. The perchlorate complex does not react with $SnCl_4$. The results show that the higher the degree of coordination saturation of the uranyl in the starting "island" complex, the greater is the degree of its "decomplexing" and there is evidently a limit of

some minimal residual charge on the coordinated ligands (corresponding to the frequency $\nu_{as}UO_2^{2+} \simeq 950$ cm^{-1}) below which the interaction of the uranyl complex with the electron donor $SnCl_4$ is impossible. (auth)

166 STUDY OF SOME CYANIDE COMPLEXES OF COBALT AND IRON BY GR EMISSION SPECTROSCOPY. Prusakov, V. E.; Stukan, R. A.; Borshchagovskii, B. V.; Gol'danskii, V. I. Sov. Radiochem. (Engl. Transl.); 16: No. 1, 66-69(1974).

Translated from Radiokhimiya; 16: No. 1, 70-74(1974).

By GR emission spectroscopy it was shown that after the decay of $^{57}Co^{2+}$ in cobalt ferro- and ferricyanides, which have the polynuclear structure of Prussian blue, the iron atom formed retains its initial position in the crystal lattice and is stabilized in a valence state characteristic of the system examined. It was confirmed that there are two types of Co^{2+} cations in these compounds. The hypothesis on the three types of cobalt(II) atoms in the compound $Co(CN)_2$ was confirmed. (auth)

167 TOPOCHEMICAL PREPARATION OF THORIUM HYDROXIDE. Sakharov, V. V.; Danilevich, T. I.; Klyuchnikov, V. M.; Voronskaya, G. N.; Korovin, S. S. Sov. Radiochem. (Engl. Transl.); 16: No. 1, 70-75(1974).

Translated from Radiokhimiya; 16: No. 1, 74-80(1974).

Crystal-like thorium hydroxide is formed by treatment of solid crystal hydrates of thorium sulfate, nitrate, and chloride with solutions of ammonia and alkali with a concentration above 0.1-1 M. In the thorium hydroxide there are hydroxo groups with a ratio $OH/Th \simeq 3$. During aging of the hydroxide the oxolation processes are retarded and occur appreciably at 100-150°C. The rate of formation of the crystalline phase is determined by the nature of the starting compound. (auth)

168 SPECTROPHOTOMETRIC STUDY OF KINETICS OF OXIDATION OF UCl_4 BY OXYGEN IN MOLTEN LiCl-KCl EUTECTIC. Gushchin, V. V.; Sabanova, T. I.; Ermakov, V. A.; Skiba, O. V.; Kazantsev, G. N.; Barinov, V. M. Sov. Radiochem. (Engl. Transl.); 16: No. 1, 76-79(1974).

Translated from Radiokhimiya; 16: No. 1, 80-84(1974).

The rate of oxidation of uranium(IV) by oxygen in a LiCl-KCl eutectic melt is a function of the uranium(VI) concentration. A mechanism is proposed for the oxidation of uranium(IV) by oxygen in a LiCl-KCl eutectic melt and on this basis a relation was obtained which makes it possible to optimize the oxidation process. (auth)

169 KINETICS OF REDUCTION OF PLUTONIUM BY HYDRAZINE. II. Reduction of Pu(IV). Koltunov, V. S.; Zhuravleva, G. I. Sov. Radiochem. (Engl. Transl.); 16: No. 1, 80-83(1974).

Translated from Radiokhimiya; 16: No. 1, 84-88(1974).

The reduction of Pu(IV) by hydrazine in HNO_3 solution with $\mu = 2$ was studied spectrophotometrically. The reaction rate is described by the equation: $-d[Pu(IV)]/dt = k[Pu(IV)][N_2H_4]/(K + [H^+])$, where $k = 0.361 \pm 0.002$ min^{-1} and $K = 0.14$ (hydrolysis constant of Pu^{4+} ions) at 50°C with $\mu = 2$. The value of k increases with an increase in μ. From the relation of k to the temperature over the range 41 to 71°C, the energy (28.8 kcal/mole) and enthalpy (28.2 kcal/mole) were calculated from energy (22.7 kcal/mole at 25°C), and the entropy (18.5 eu) of activation of the reaction and also the formal entropy of the activated complex $S^* = -19$ eu. At a high temperature with low concentrations of N_2H_4 and H^+ ions part of the Pu(IV) is reduced through disproportionation. The mechanism of the reaction between Pu(IV) and N_2H_4 is discussed. (auth)

170 STANDARD ENTHALPIES OF FORMATION OF ALKALI METAL AND AMMONIUM PENTAFLUORODIURANYLATES. Suponitskii, Yu. L.; Seleznev, V. I.; Mukhametshina, Z. B.; Bodrov, V. G.; Karapet'yants, M. Kh.; Sudarikov, B. N. Sov. Radiochem. (Engl. Transl.); 16: No. 1, 84-87(1974).

Translated from Radiokhimiya; 16: No. 1, 88-91(1974).

The enthalpies of dissolution of uranyl fluoride and also alkali metal and ammonium pentafluorodiuranylates in 2 M HCl at 25°C were measured by a calorimetric method. The enthalpies of dissolution of alkali metal and ammonium fluorides in a solution of uranyl fluoride in 2 M hydrochloric acid were determined. On the basis of the experimental data we calculated the standard enthalpies of formation of $Na(UO_2)_2F_5$, $K(UO_2)_2F_5$, $Rb(UO_2)_2F_5$, $Cs(UO_2)_2F_5$, and $NH_4(UO_2)_2F_5$ from the alkali metal or ammonium fluoride and uranyl fluoride and these were found to equal -8.15 ± 0.39, -18.64 ± 0.38, -23.28 ± 0.91, -27.32 ± 1.03, and -12.99 ± 0.69 kcal/mole, respectively, at 298.15°K. Using literature data we found the standard enthalpies of formation from the elements of $Na(UO_2)_2F_5$, $K(UO_2)_2F_5$, $Rb(UO_2)_2F_5$, $Cs(UO_2)_2F_5$, and $NH_4(UO_2)_2F_5$, which equaled -939.1 ± 3.2, -947.9 ± 3.2, -951.3 ± 5.3, -954.0 ± 3.7, and -917.8 ± 3.7 kcal/mole, respectively, at 298.15°K. (auth)

171 ENTHALPY AND HEAT CAPACITY OF NEPTUNIUM DIOXIDE IN THE TEMPERATURE RANGE OF 350 to 1100°K. Arkhipov, V. A.; Gutina, E. A.; Doretsov, V. N.; Ustinov, V. A. Sov. Radiochem. (Engl. Transl.); 16: No. 1, 122-124(1974).

Translated from Radiokhimiya; 16: No. 1, 123-126(1974).

A description is given of a calorimetric apparatus and a measurement procedure that makes it possible to obtain quite reliable experimental values of enthalpy and heat capacity with the small amounts of the substance investigated with which it is necessary to work. The values obtained for the heat capacity at room temperatures are 17% higher than the values in E. Westrum, J. B. Hatcher, and D. W. Osborn, J. Chem. Phys. 21(3), 419 (1953). This difference is explained primarily by the purity of the substances investigated and also by the use of different measurement methods and the temperature region in which these methods were used. (auth)

172 EFFECT OF THE DEGREE OF DISPERSITY ON THE CHARACTER OF THE THERMAL BEHAVIOR OF EPSILON-UO_3. Kozhina, I. I.; Bykov, V. A.; Malinin, G. V. Sov. Radiochem. (Engl. Transl.); 16: No. 1, 125-126(1974).

Translated from Radiokhimiya; 16: No. 1, 126-127(1974).

It was shown that the character of the thermal behavior of samples of ϵ-UO_3 depends on their dispersity. For coarsely disperse samples the thermal decomposition of ϵ-UO_3 to U_3O_8 occurs in two stages: ϵ-$UO_3 \xrightarrow{450°C} UO_x \xrightarrow{580°C} U_3O_8$, where $2.79 \leq x < 2.90$ (the exact value of x depends on the degree of dispersity). Finely dispersed ϵ-UO_3 decomposes to uranosouranic oxide in one stage. The region of homogeneity of ϵ-UO_3 is narrow (samples with the composition $UO_{2.97}$ consist of two phases). (auth)

173 FORMATION OF LABELED PHENYLTHIOHYDANTOIN DERIVATIVES (PTH) OF AMINO ACIDS BY REACTIONS OF ACCELERATED TRITIUM ATOMS WITH ENERGIES OF 0.4 TO 0.5 keV. Baratova, L. A.; Dzantiev, B. G.; Shimchuk, O. S.; Shichkov, A. V. Sov. Radiochem. (Engl. Transl.); 16: No. 1, 132-134(1974).

Translated from Radiokhimiya; 16: No. 1, 131-133(1974).

The PTH derivatives of the unknown amino acid obtained are bombarded with fast tritium atoms on an apparatus, which is described in the paper. A considerable part of the tritium atoms are stabilized in the form of the mother compound to form labeled PTH derivatives. Then PTH derivatives of known amino acids are added to the irradiated target as carriers, and the mixture is separated by the usual chromatographic method. The unknown PTH derivative is identified by comparing the R_f values of the spots of known PTH derivates of amino acids and the radioactive spot. The yield of labeled PTH-amino acids was of the order of 1-10% as was practically independent of the energy of the bombarding particles over the range of 0.5-3 keV, but depended linearly on the irradiation time for up to 30 min. The specific activities were of the order of 1 mCi/g. (LK)

174 RADON DIFFUSION AND MIGRATION AT LOW PRESSURES, IN THE LABORATORY, AND ON THE MOON. Friesen, L. J. Houston, TX; Rice Univ. (1974). 90p. University Microfilms Order No. 74-21,270.

Thesis (Ph. D.).

The random-walk migration of radon through columns of finely divided National Bureau of Standards Glass Spheres (Standard Reference Material 1003), commercially available glass spheres (Emerson & Cuming Eccospheres, IG-101), activated coconut charcoal, Lipari glass, and W-1 Standard Diabase, under moderate vacuum conditions ($2\text{-}20 \times 10^{-2}$ torr) such that the mean free path of the random walk was determined primarily by interparticle void dimensions rather than gas pressure, has been monitored by an alpha-disintegration counter. From the rates of migration, diffusion coefficients were calculated, and from these diffusion coefficients, heats of adsorption of radon on these materials were derived. Values found for heats of adsorption at room temperature (296-300°K) were: 8.2 kcal/mole for SRM 1003; 9.0 kcal/mole for IG-101; 8.6-9.3 kcal/mole for charcoal; 9.6 kcal/mole for Lipari; ≤14.6 kcal/mole for W-1. These values exceed an estimate based on extrapolation from heats of adsorption of other noble gases on graphite. Further, heat of adsorption in this range of values is found to make random walk a far less important process for redistributing radon and its daughter isotopes on the Moon and other airless planetary bodies, than previously theoretically estimated (in one calculation, reduces probability of radon escape from 4-meter depth of regolith to lunar surface fourfold). (Diss. Abstr. Int., B)

175 THERMODYNAMIC STUDY OF THE ACTINIDE MONOFLUORIDES AND THE EFFECTS OF CHANGES IN IONIC MEDIA. Unrein, P. J. Tallahassee, FL; Florida State Univ. (1974). 152p. University Microfilms Order No. 74-21,722.

Thesis (Ph. D.).

A systematic study of the actinide monofluoride complexes was made to determine the nature of the bonding involved and to provide a more complete picture of the chemical behavior of these heavy metal ions in aqueous solution. The stability constants for the formation of the monofluoride complexes of trivalent Am, Cm,

Bk and Cf were determined by a solvent extraction technique in 1.0M ($NaClO_4$) ionic medium at 25°C. The values for tetravalent Th, U and Np were determined by solvent extraction and/or potentiometric titration, using the fluoride ion selective electrode, in a 1.0M ($HClO_4$) ionic medium at 25°C. The thermodynamic parameters of complex formation were obtained by the temperature differential method. By comparing these thermodynamic values with those determined by other authors for the Group IIA, IIIA and lanthanide monofluoride complexes, it was concluded that the actinide complexes are inner sphere complexes. Further investigation was made into the effect the supporting electrolyte has on the complex stability of the inner sphere complex, EuF^{2+}. Stability was measured in 1M solutions of $HClO_4$, $NaClO_4$, $LiClO_4$ and 0.5M solutions of $HClO_4$, $NaClO_4$, $LiClO_4$ and NH_4ClO_4. Thermodynamic parameters were determined by the temperature differential method. The experimental evidence indicates that the media has considerable influence on the measured complex stability and therefore comparison of stability constants measured in one ionic medium should not be made with those measured in another ionic medium, even though the ionic strengths are large and constant. Activity coefficient corrections to the data would seem warranted, whenever possible, since the order of stability follows the increase order of activity coefficients for the bulk electrolyte and is attributed to the hydrational effects caused by the bulk electrolyte. (Diss. Abstr. Int., B)

176 KIT PREPARATION OF RADIOIODINATED AUTOLOGOUS FIBRINOGEN USING ^{131}I-MONOCHLORIDE. Hagan, P.; Loberg, M. D.; Rhodes, B. A.; Harrison, K.; Cooper, M. D. (Univ. of Maryland, Baltimore). J. Nucl. Med.; 15: No. 11, 974-980(Nov 1974).

A rapid method for the production of ^{131}I-labeled autologous fibrinogen (RAF) is given. The method is complete within 1 hr, can be conveniently handled in kit form, produces fibrinogen that is 85 to 90% clottable, and eliminates the risk of serum hepatitis transmission. Iodination yields of 48 to 60% were obtained over a range of iodine-to-fibrinogen ratios of 0.5 to 3.0 using the Helmkamp modification of the iodine monochloride labeling procedure. The physicochemical damage to the fibrinogen molecule owing to the radiolabeling procedure was determined by chromatographing RAF on Bio Gel A 1.5 m and 15 m. The biologic authenticity of RAF was assayed employing both plasma clearance and tissue-distribution studies in dogs. Plasma half-lives of 52 to 58 hr were found corresponding to the known rate of fibrinogen catabolism in dogs. Three and one-half, 6, and 7.6% of the injected RAF was found in the thyroid, stomach, and liver, respectively, at 24 hr. The results indicate that this rapid method produces biologically active radiolabeled fibrinogen suitable for routine clinical use. (auth)

Radioactive Waste Treatment

Refer also to abstracts 522, 827, 1287, 1294, 1296, and 1301.

177 CALCULATION OF ACTIVITY AND RADIATION CONDITIONS IN EVAPORATORS FOR PURIFYING CONTAMINATED WATER. Eschner, G.; Fiebig, C.; Krueger, F. W. (Kraftwerksanlagenbau, Berlin). Kernenergie; 17: No. 6, 170-173 (Jun 1974). (In German).

A computer program for analyzing the activity and radiation conditions in a two-stage evaporator is described. The results of a special numerical case are presented and discussed. (auth)

178 RECOVERY OF Pu AND Am FROM ALPHA-BEARING AQUEOUS WASTES. III. Akatsu, J. (Japan Atomic Energy Research Inst., Tokai). Radiochem. Radioanal. Lett.; 19: No. 1, 33-42(13 Oct 1974).

When Pu and Am were fixed as their hydroxides from α-bearing aqueous wastes, trace amounts of them remained in the solutions. It was found in alkaline solution that Pu(III) and Pu(VI) are instantly converted into Pu(IV) with dilute H_2O_2, at room temperature, and Pu(IV) can be fixed by scavenging with $Fe(OH)_3$. Approximately 6 g of Pu and 12 mg of Am were recovered from about 90 l of miscellaneous aqueous wastes (~7 mCi/l), with a recovery efficiency of >90%. The α-activities of supernatant solutions were ~3 μCi/l. (auth)

179 RECOVERY OF Pu AND Am FROM ALPHA-BEARING AQUEOUS WASTES. II. Akatsu, J. (Japan Atomic Energy Research Inst., Tokai). Radiochem. Radioanal. Lett.; 19: No. 1, 25-32(13 Oct 1974).

From α-bearing aqueous wastes, Pu and Am were fixed as their hydroxides and separated by decantation. The supernatant solutions were decontaminated with $Fe(OH)_3$, while the slurry was dissolved with HNO_3 to give a Ca- or Na-nitrate solution, from which Pu and Am were recovered by DBP (or TBP) solvent extraction. Approximately 8 g of Pu and 130 mg of Am, with about 85% yield, were recovered from 130 l of aqueous wastes containing ~12 mCi, α/l. The gross α-activity in the decontaminated solution was ~10 μCi/l. (auth)

180 HANDLING OF RADIOACTIVE WASTE. Smeets, L. (Stichting Reactor Centrum Nederland, The Hague). Atoomenergie Haar Toepass.; 16: No. 7-8, 161-165(Jul 1974). (In Dutch).

These may be solid, liquid, or gaseous, long, medium, or short term. The long-term waste produced at the Dutch radioactivity centre is packed into 100 l drums, surrounded by concrete, and dumped in the Atlantic Ocean; the total quantity is approximately 2000 t/yr. Bitumen is particularly suitable for fixing of other types of waste. (NL)

181 REMOVAL OF ^{90}Sr and ^{137}Cs FROM LOW-LEVEL RADIOACTIVE LIQUID WASTE BY MEANS OF FOAM SEPARATION. Wei, S. N.; Tsai, M. S.; Wu, S. C. (Inst. of Nuclear Energy Research, Lung-Tan, Taiwan). Nucl. Sci. J. (Taiwan); 11: No. 2, 90-99(Jun 1974).

Four kinds of surfactants, namely; SDBS (sodium dodecyl benzene sulfonate), SDS (sodium dodecyl sulfate), NaOL (sodium oleate), and DAA (dodecyl amine acetate), were selected as foam reagents for preliminary study on the removal of ^{90}Sr and ^{137}Cs from radioactive liquid waste. It was observed that SDBS and SDS were effective for the removing of ^{90}Sr. On the other hand, DAA and NaOL are good for the removing of ^{137}Cs. The effects of interfering ions and pH value on the separation of ^{90}Sr and ^{137}Cs were also investigated. (auth)

182 BITUMINIZATION OF RADIOACTIVE WASTE. Hayashi, T. (Ebara Mfg. Co. Ltd., Tokyo). Genshiryoku Kogyo; 20: No. 1, 49-53(Jan 1974). (In Japanese).

The very short history and present status of the bituminization of radioactive wastes are reviewed. The process of bituminization is explained by a flow diagram. The history of research and development in European countries and the USA is also given. Two types of plants now in practical service, extruder type and wiped film evaporator type, are shortly reviewed and compared. A process chart of continuous bituminization is given for each type of the plants. Various types of wastes to be solidified by the bituminization process are enumerated, and the relation between final density and mixing ratio is shown for each type of the wastes. The screw extruders with two and four axes and the wiped film evaporator are explained. The examples of actual plants of both types are also presented. The amount of tar and oil contained in condensed water and decontamination factor are shortly reviewed. The easiness of cleaning plants is also explained as compared with cement solidification. Finally, it is suggested that the wiped film evaporator is more suitable for power plants. (JA)

183 TREATMENT OF AQUEOUS EFFLUENTS FROM $UF_6(g) \rightarrow (NH_4)_4[UO_2(CO_3)_3](s) \rightarrow UO_2(s)$ CONVERSION. Dokuzoguz, H. Z. (Babcock and Wilcox Co., Lynchburg, VA); Muller, H. M. Environ. Sci. Technol.; 8: No. 12, 1014-1017(Nov 1974).

Increasing use of the $UF_6(g) \rightarrow (NH_4)_4[UO_2(CO_3)_3](s) \rightarrow UO_2(s)$ conversion process for manufacturing UO_2 fuels has led to the development of different processes to treat the aqueous effluents generated during several stages of the UO_2 conversion. The mixture of these effluents contains large amounts of NH_4^+, $CO_3^{=}$, F^-, and a relatively small amount of U. This article describes a novel treatment process comprising four main stages. These aim at the recovery of CO_2 by acidification through a unique gas liberation circuit, the precipitation of U as $UO_4 \cdot 2NH_3 \cdot 2HF$ (a novel compound), the removal of F^- by precipitation, and the recovery of NH_3 and part of the H_2O by distillation and rectification of the two latter components, respectively. The CO_2, NH_3, H_2O, and U so recovered can be returned to the conversion process, while the treated effluents and the $CaF_2/Ca(OH)_2$ solid, which meet currently accepted or anticipated environmental standards, can be safely discarded. (auth)

Radioisotope Production

Refer also to abstracts 55 and 667.

184 (AED-CONF-73-402-045) RAPID PREPARATION OF FLUORINE-18 BY MEANS OF NUCLEAR RECOIL SEPARATION. Parker, W. C.; da Silva, C. P. G.; Francis, W. H. G. (Instituto de Energia Atomica, Sao Paulo (Brazil)). 1973. 7p. INIS.

From 7th international hot atom chemistry symposium; Juelich, F. R. Germany(10 Sep 1974).

The application of "hot atom chemistry" to the rapid preparation of ^{18}F ($t_{1/2}$ = 109.7 min) is described. In this particular case, slurry, or paste targets, of lithium carbonate and distilled water were prepared and subjected to irradiation in the reactor thus $^6Li(n,\alpha)^3H$ and $^{16}O(t,n)^{18}F$. Following the irradiation > 90% of the fluorine activity produced in the above reaction is found in the

water component of the target and 70% of this can be recovered with a single extraction of water. Using a dilute solution of NaOH, containing a trace quantity of fluorine carrier as NaF, yields as high as 98% can be realized. Parameters investigated included yield as a function of Li_2CO_3/H_2O target ratio, and type and temperature of extractant. The described method allows the quantitative recovery of the enriched 95% lithium carbonate and, very important, reduces the conventional separation time from 60-90 minutes to 7-15 minutes depending on the final concentration required for the preparation. Because of its short half-life, ^{18}F is favored as an isotope for brain tumor scanning. (INIS)

185 (MLM-2168, pp 31-37) SEPARATION CHEMISTRY. 30 Aug 1974.

In Mound Laboratory activities for the Division of Physical Research: January–June 1974.

A facility to recover ^{231}Pa and ^{230}Th from Cotter concentrates was put into regular operation; 8 g of ^{230}Th and 25 mg ^{231}Pa have been recovered. In the separation of ^{229}Th from aged ^{233}U, 7.3 mg of ^{229}Th were recovered. Recovery and purification of ^{234}U from aged ^{238}Pu materials produced 9.611 g ^{234}U. (LK)

186 RAPID GAS-THERMOCHROMATOGRAPHIC SEPARATION OF RADIOACTIVE ELEMENTS. II. Gold as a Universal Target for the Rapid Production of Radioactive Re, Os, Ir, and Hg Isotopes. Bayar, B.; Novgorodov, A. F.; Vocilka, I.; Zaitseva, N. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Radiochem. Radioanal. Lett.; 19: No. 1, 43-53(13 Oct 1974).

The volatilization-deposition behavior of ultra-microamount of volatile oxides of Re, Os, Ir and Hg was studied when evaporating them in a stream of oxygen, air and helium from the melt of gold irradiated with 660-MeV protons. It was shown that when the mixture of gaseous products is passing along the thermochromatographic quartz column, having negative temperature gradient, the volatile oxides deposit (with the temperature decrease) in different zones as follows: Re, Ir, Hg and Os. The mechanism of the formation and the behavior of these oxides in the processes of their evaporation from the Au melt and deposition on the tube walls are discussed. Based on the data obtained, the rapid gas-thermochromatographic method is suggested for the production of radioactive samples of Re, Os, Ir and Hg from the gold target. (auth)

187 ADSORPTION BEHAVIORS FOR ISOLATION OF PROTACTINIUM-233 TRACER BY SILICA GEL. Chang, H. P.; Ho, C. K.; Ting, G.; Wu, S. C. (Inst. of Nuclear Energy Research, Lung-Tan, Taiwan). Nucl. Sci. J. (Taiwan); 11: No. 2, 73-81(Jun 1974).

The best condition for adsorption of protactinium-233 on silica gel from nitric acid solution was 8 to 10M HNO_3. The distribution coefficient for the adsorbable species of protactinium-233 and the percentage of the unadsorbable protactinium-233 in 10M HNO_3 solution containing 0.12g Th/l were determined. The adsorption rate and the effect of thorium concentration on the adsorption have also been studied. Column experiment with tracer concentration of protactinium-233 showed that more than 98% of the protactinium-233 was adsorbed from 10M HNO_3 feed solution containing 2g Th/l and more than 96% of the protactinum-233 adsorbed on silica gel was eluted with 8 ml 0.5M oxalic acid. The chemical and radiochemical purity of the isolated protactinium-233 was checked by spot test and γ spectrum. (auth)

188 POSSIBILITY OF USING SULFONATED POLYETHYLENE AND POLYVINYL ALCOHOL FILMS FOR PREPARING SOURCES BASED ON ^{55}Fe. Danilin, L. D.; Pavlova-Verevkina, A. I. Sov. Radiochem. (Engl. Transl.); 16: No. 1, 130-131(1974). Translated from Radiokhimiya; 16: No. 1, 130-131(1974).

For preparation of ^{55}Fe sources, the film is treated with ~1N HCl, washed with distilled water, and placed in a vessel containing the active isotope. After 2-3 days the film is extracted from the vessel, washed with water, and dried. This method was used to prepare a film with a surface of 20 cm^2 containing ~90 μCi of ^{55}Fe. (LK)

189 RADIOCHEMICAL PURIFICATION OF IRON-55 BY AN ELECTROCHEMICAL METHOD. Danilin, L. D.; Pavlova-Verevkina, A. I. Sov. Radiochem. (Engl. Transl.); 16: No. 1, 127-129(1974).

Translated from Radiokhimiya; 16: No. 1, 128-130(1974).

A study was made of the electrochemical separation of iron and manganese from sulfate electrolytes. It was shown that the inclusion of ^{54}Mn in the cathode deposit of iron is small (~10^{-4}), but increases with a decrease in the pH and an increase in the current density. In the presence of Trilon B and sodium bitartrate (5 g/liter) the codeposition of ^{54}Mn increases. Ammonium and sodium oxalates and sulfates hardly affect the codeposition. An attempt was made to explain the effect of complex formation. (auth)

Reactor Fuel Reprocessing

Refer also to abstracts 34 and 831.

190 (ORNL-TM-3352) ENGINEERING DEVELOPMENT STUDIES FOR MOLTEN-SALT BREEDER REACTOR PROCESSING NO. 10. McNeese, L. E. (Oak Ridge National Lab., Tenn. (USA)). Dec 1972. Contract W-7405-eng-26. 108p. Dep. NTIS $8.50.

Research progress is reported on the following programs: frozen-wall fluorimeter development, semicontinuous reductive extraction experiments in a mild-steel facility, development of the metal transfer process, distribution of radium between LiCl and Li–Bi solutions, development of mechanically agitated salt-metal contactors, analysis of multicomponent mass transfer between molten salts and liquid bismuth during countercurrent flow in packed columns, uranium oxide precipitation, and purification of salt by continuous methods. (MCG)

CONTROLLED THERMONUCLEAR RESEARCH

Confinement and Heating

Refer also to abstracts 271, 289, and 305.

191 (AD-773408) ELECTROMAGNETIC INSTABILITIES, FILAMENTATION, AND FOCUSSING OF RELATIVISTIC ELECTRON BEAMS. Lee, R.; Lampe, M. (Naval Research Lab., Washington, D. C. (USA)). Jan 1974. 14p. (NRL-MR-2681. NTIS $3.00.

Nonlinear studies are reported of the Weibel instability of a relativistic electron beam in a plasma. If $(n_b) \ll (n_p)$, the beam splits into self-pinched filaments at density (n_p). These filaments then recombine into a single dense beam, from which the return current is expelled. A fraction about v/γ of the beam energy is lost to magnetic energy, and significant plasma heating occurs. (auth)

192 (AEC-tr-7562) INJECTION OF ELECTRONS AND CONFINEMENT OF PLASMA IN MULTIGAP ELECTROMAGNETIC TRAP. Lavrent'ev, O. A.; Sidorkin, V. A.; Goncharenko, V. P.; Azovskii, Yu. S. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). Oct 1974. Translation of KHFTI-74-3. 10p. Dep. NTIS $4.00.

The injection of electrons in a multigap electromagnetic trap is investigated. The plasma, generated as a result of ionization of residual gas, is confined by a system of external magnetic and electric fields. The electron lifetime is determined as a function of the parameters of the trap and ion temperature. (auth)

193 (COO-3715-2) HEATING AND CONFINEMENT STUDIES OF LASER IRRADIATED SOLID PARTICLE PLASMAS. Lubin, M. J.; Dunn, H. S.; Friedman, W. (Rochester Univ., N. Y. (USA). Dept. of Mechanical and Aerospace Sciences). 1968. 32p. (CONF-680805-31). Dep. NTIS $4.75.

From 3rd international conference on controlled and plasma physics; Novosibirsk, USSR (1 Aug 1968).

The plasma formed by vaporization of a small solid particle of lithium hydride, electrodynamically suspended in hard vacuum, with a "tailored" laser pulse is studied. It is shown that proper shaping of the initial leading edge of the laser pulse such that the particle is completely vaporized prior to the main heating and subsequent expansion leads to enhanced energy absorption. At peak laser powers of 1.51×10^9 watts the peak measured temperatures in the expanding plasma, with no confining magnetic field, are in excess of 160 eV, while the measured average energies per particle in a fully ionized symmetrically expanding plasma containing 10^{16} ions, are 1 keV. Temperature measurements are carried out by light scattering and expansion energy is obtained using integrated charge collection probes and a 5.3 mm microwave interferometer. Preliminary work on the interaction of this expanding plasma with a uniform magnetic field is presented. The theoretical radiation expected in the case of weak interaction with the uniform field is examined. In particular, the radiation intensity is presented for (a) the dipole radiation due to surface currents during the initial stages of expansion, (b) cyclotron surface radiation and (c) the volume cyclotron radiation during the later stages of the plasma expansion. A comparison of far infrared and millimeter measurements displays reasonable agreement with the predicted development in time of the plasma radiation. Results of initial confinement studies in a non-zero minimum B magnetic field generated by a "baseball winding" are presented. Measurement of containment times with a microwave interferometer and flux probes indicate that densities of $10^{12}cm^{-3}$ are retained in a volume of $30cm^3$ for times in excess of 400 μsec, in a 20 KG field. Of particular interest is the apparent flute-like behavior at fields below 8 KG. (auth)

194 (EUR-CEA-FC-726) ENERGY EFFICIENCY OF FAST NEUTRAL PARTICLE INJECTION HEATING IN T.F.R. Dei-Cas, R.; Marty, D. (Australian National Univ., Canberra. Dept. of Geophysics and Geochemistry; CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Jan 1974. 56p. (In French). Dep. NTIS (US Sales Only) $6.00.

The power required of fast neutral particles to induce transitions of T.F.R. plasma ions into the noncollisional diffusion regime (banana regime) is evaluated, impurities and charge exchange losses being taken into account. The results of statistical calculations of the effect of fast ion collisions with the plasma on diffusion in velocity space and real space are presented. The overable energy efficiency of neutral particle heating is evaluated. (FR)

195 (LA-5656-PR, pp 57-70) IMPLOSION HEATING EXPERIMENT. Hammel, J. E.; Henins, I.; Marshall, J.; Sherwood, A. R. Jul 1974.

In LASL Controlled Thermonuclear Research Program.

A brief historical review of the implosion heating experiment is given. The current system for the experiment is discussed. The system consists of Marx banks utilizing low-inductance capacitor connections and rail-gap load switches. Edge insulation for parallel plate lines, overvoltage protection, prevention of flashover by conducting plastic, fast resistive dividers for high voltages, and stabbed-polyethylene switch developments are briefly discussed. Preionization and computer modeling of the heating are also briefly described. (MOW)

196 (LA-5656-PR, pp 105-115) EXPERIMENTAL PLASMA PHYSICS RESEARCH PROGRAM. Jul 1974.

In LASL Controlled Thermonuclear Research Program.

During the past year the LASL Plasma Physics Research (PPR) program continued to be devoted to the study of the plasma ac electrical resistivity and plasma heating produced by the application of high-frequency electromagnetic radiation to fully ionized plasmas. This research centers on the dependence of the classical and anomalous resistivity on the value of the applied electric field. The work includes measurement of the electron velocity distribution as modified by high-frequency heating, and, where feasible, determines the spectrum and intensity of plasma waves excited by the heating process. The resistivity is measured in two different regimes, a classical stable and an anomalous turbulent regime. (MOW)

197 (ORNL-4982, pp 1-12) ORMAK PROGRAM. Bates, D. D.; Berry, L. A.; Clarke, J. F. Sep 1974.

In Thermonuclear Division annual progress report for period ending December 31, 1973.

Research progress is briefly discussed for the following topics: (1) ohmically heated experiments, (2) neutral beam injection experiments, (3) Ormak planning and edgineering group, and (4) fusion dynamics of lossy reactor systems. (MOW)

198 (ORNL-4982, pp 13-20) PLASMA THEORY AND COMPUTATION. Beasley, C. O. Jr.; Betz, N. A.; Brooke, P. D. Sep 1974.

In Thermonuclear Division annual progress report for period ending December 31, 1973.

Summaries are given of research dealing with the following three areas of interest: (1) plasma confinement and heating in tokamaks, (2) plasma confinement and heating in the ELMO bumpy torus, and (3) confinement and heating in magnetic mirrors. (MOW)

199 (ORO-4211-15) MAGNETIC MIRROR CLOSURE AND DIRECT ENERGY RECOVERY FOR FUSION DEVICES, 1.1.A. Alexeff, I. (Tennessee Univ., Knoxville (USA)). 1974. Contract AT(40-1)-4211. 11p. Dep. NTIS $4.00.

It is demonstrated mathematically how magnetic mirrors may possibly be "closed"— end losses dramatically reduced— by changing the shape of the confining magnetic field in a slow, programmed fashion. In addition, much of the energy formerly lost by particles escaping through the loss cones may be recovered by means of a very efficient MHD process inherent in the mirror closure technique. (auth)

200 (ORO-4211-16) MAGNETIC MIRROR CLOSURE AND DIRECT ENERGY RECOVERY FOR FUSION DEVICES, 1.1.B. Alexeff, I. (Tennessee Univ., Knoxville (USA)). [nd]. 18p. Dep. NTIS $4.00.

It is demonstrated mathematically how magnetic mirrors may possibly be "closed" and end losses dramatically reduced, by changing the shape of the magnetic field in a slow, programmed fashion. (auth)

201 (UCID-15774) PLASMA CONFINEMENT IN A TOROIDAL FIELD MODIFIED BY THE E-LAYER FIELD. Christofilos, N. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Dec 1970. 15p. Dep. NTIS $4.00.

Calculations are given that indicate that an absolute minimum B can be created in the toroidal field with a positive gradient larger by a factor of two than the natural negative gradient of the toroidal field. In this way the minimum value of the positive gradient of the toroidal field is equal to the value of the inward positive gradient of the toroidal field in existing toroidal confinement experiments. This magnitude of gradient should be satisfactory for plasma confinement inasmuch as it has been observed in zero gradient confinement experiments that the plasma is stable. (MOW)

202 (UCID-15875) ECR HEATING AND HOT ELECTRON PLASMA INTERCHANGE STABILITY IN THE SCL. Hartmen, C. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Jun 1971. 14p. Dep. NTIS $4.00.

Electron cyclotron heating and the confinement of hot electrons in levitron-like magnetic fields are discussed. The conditions under which two electron temperature components can be present are discussed. An approximate stability analysis is given for conditions where two electron components are present in sheared magnetic fields and where the hot electron component is mirror confined in regions of destabilizing field curvature. The "twisted" interchange mode, which can occur in the hot electron plasma in the presence of shear because of mirror confinement along B, is found to be stabilized by a relatively tenuous, isotropic cold electron component. Stabilization is provided by shear, analagous to line tying in open-ended configurations, but is more effective since current inhibiting ion sheaths are not present. Approximate stability conditions are $\lambda_e r_p / L L_s \gtrsim (a_{eh}/r_p)(T_e/T_h)^{1/2}$ if the cold plasma is collisional and $n_{oe}/n_{oh} \gtrsim T_e/T_h$ if the cold plasma is collisionless, where λ_e is the cold electron mean-free-path, $r_p = n_0/n_0$, L is the connecting length between mirror regions, and L_s is the shear length. (auth)

203 INJECTION AND CONTROL OF INTENSE RELATIVISTIC ELECTRON BEAMS IN A TORUS. Benford, J.; Ecker, B.; Bailey, V. (Physics International Company, San Leandro, California 94577). Phys. Rev. Lett. 33: No. 10, 574-577 (2 Sept 1974).

Efficient injection (>80%) of an intense relativistic electron beam into a torus has been achieved using curvature drift injection. Drift was stabilized with a supplemental dipole magnetic field but beam loss in the radial direction due to the defocusing effect of the dipole field limited containment time. We propose a system for beam trapping and confinement which employs drift injection and beam energy losses in a toroidal-plus-beta-tron-type field. (auth)

204 ION HEATING BY AN INTENSE RELATIVISTIC ELECTRON BEAM. VanDevender, J.P.; Kilkenny, J.D.; Dangor, A.E. (Imperial College, London SW7 2BZ, England). Phys. Rev. Lett. 33: No. 12, 689-692 (16 Sept 1974).

A high-current electron beam is used to produce a plasma from neutral hydrogen. Doppler-line-broadening and Thomson-scattering measurements show that the ion energy is 100 ± 15 eV compared with only 12 ± 2 eV for the electron energy. It is shown that this ion energy can be supplied by an inverse pinch effect. It is suggested that much higher ion energies will result for electron densities n_e lower than 10^{15} cm^{-3} measured here. (auth)

205 COMPRESSION OF MATTER TO SUPERHIGH DENSITIES BY AN ACCELERATING HEAT WAVE. Mikoshiba, S.; Ahlborn, B. (Department of Physics, University of British Columbia, Vancouver 8, British Columbia, Canada). Phys. Fluids 17: No. 6, 1198-1206 (June 1974).

A one-dimensional analytical model is presented for the compression of matter (e.g., thermonuclear fusion fuel to densities of more than 10^3 times the solid density) by an accelerating subsonic heat wave. The heat wave, driven possibly by the absorption of a temporally tailored laser pulse, launches a large number of successive weak shock waves which compress and heat the target quasiadiabatically in order to keep the energy expenditure at a minimum. The net power to drive this heat wave must have a stepwise increase in time approximated by $W = (9/8)\rho_0 c_0^3 K^2/\tau^2$, where $K = D_f\rho_f/D_0\rho_0$ is the fraction of the initial target mass (of density ρ_0 and thickness D_0) which reaches the final state (of ρ_f and D_f). The adiabatic condition sets the requirement that K should be much smaller than one. The time t is scaled as $\tau = 1 - t/t_s$, where $t_s = D_0/c_0$ and c_0 is the intial sound speed. The sound speed in the compressed matter, from which pressure and density can be obtained using the adiabatic equations of state, will increase approximately as $c_0 (K/\tau)^{1/4}$. Half of the total driving energy is expended by the time $t_f[\tau_f = (D_f/D_0)(\rho_0/\rho_f)^{1/3}]$, from which time the power has to be held constant at $W_f = (9/8)(\rho_f/\rho_0)^{8/3}\rho_0 c_0^3$ until time t_s. (auth)

206 NONLINEAR MAGNETOHYDRODYNAMIC STABILITY AND PLASMA CONTAINMENT WITH CLOSED FIELD LINES. Spies, G.O. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012). Phys. Fluids 17: No. 6, 1188-1197 (June 1974).

Previous formulations of the nonlinear energy principle of ideal magnetohydrodynamics in toroidal geometry cease to be relevant for stability if all magnetic field lines are closed. On the other hand, nonlinear stability is more vital in this degenerate case because the conservation laws cease to prevent plasma from touching the wall. The appropriate formulation of the nonlinear energy principle is given for this case, and from this the necessary and sufficient condition is derived for stability to finite line-preserving perturbations. Apart from the well known requirement of stability to infinitesimal interchanges and flutes deducible from the linear theory, this condition contains the additional requirement that the level surfaces of the quantities $q = \oint dl/B$, $I = \oint dl$ B, and the pressure p, coincide globally. It is further shown that nonlinear stability is compatible with containment only if the (purely geometrical) quantity $A = Iq$ attains its minimum at the wall. The entire analysis is completely general and fully nonlinear. (auth)

207 HIGH POWER FUNDAMENTAL AND HARMONIC RESONANT ION CYCLOTRON HEATING IN A MIRROR MACHINE. Clark, R.W.; Swanson, D.G. (Electronics Research Center, The University of Texas at Austin, Austin, Texas 78712); Korn, P.; Sandel, F.; Robertson, S.; Wharton, C.B. Phys. Fluids 17: No. 6, 1322-1328 (June 1974).

Radio frequency heating at powers up to 1 MW and pulse widths of ~700 μsec was applied to a turbulently preheated hydrogen plasma in a large pulsed mirror machine. Energy analysis of charge exchange neutrals indicates that resonant heating occurred when the radio frequency matched either the ion cyclotron frequency or one of its harmonics. The behavior of the induced rf fluctuations in the plasma was observed by means of microwave scattering. These measurements show resonance phenomena and the presence of rf fluctuations at harmonics of the rf heating frequency. Diamagnetic loop measurements indicate that $310 \leq (Te + T_i) \leq 380$ eV as a result of the heating, while measurements of the ion energy distribution by charge exchange energy analysis shows the ion energy distribution to be non-Maxwellian with a low temperature component of $T_i \sim 320$ eV. Microwave interferometer measurements indicate densities of ~2 to 3×10^{13} cm^{-3}. (auth)

208 PLASMA EXPERIMENTS ON THE LINEAR SCYLLAC THETA PINCH. Thomas, K.S.; Harris, H.W.; Jahoda, F.C.; Sawyer, G.A.; Siemon, R.E. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Fluids 17: No. 6, 1314-1321 (June 1974).

Experiments on a 5-m-long theta pinch both with and without strong magnetic mirrors ($R \approx 2.5$) are reported. When the experiment is operated without magnetic mirrors, the particle loss rate is found to scale from shorter theta-pinch experiments directly as the length and inversely as the ion thermal velocity. The electron temperature scales with length ($l^{2/5}$) as predicted by a theory which accounts for thermal conduction to the ends. Addition of the magnetic mirrors increases plasma confinement time from 11.5 to 18.9 μsec, a smaller increase than predicted by available theories, and also produces an $m = 1$, $k \approx 0$ instability which is moderated under certain conditions by "line tying" effects. (auth)

209 VISCOUS STRESS TENSOR EFFECTS IN LOW-PRESSURE TOROIDAL PLASMA CONFINEMENT. Hellberg, M.A.; Winsor, N.K.; Johnson, J.L. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 17: No. 6, 1258-1259 (June 1974).

Calculations employing a numerical magnetohydrodynamic toroidal plasma simulation model show that contributions to the viscous stress tensor in the momentum balance equation, which are associated with bulk viscosity and magnetic field line curvature, are as important as the usual approximation, a term proportional to $\partial^2 v_b/\partial l^2$ with v_b and l directed along the field. (auth)

210 DIFFUSION OF PLASMA CONFINED IN STELLARATOR WITH $\epsilon_l > \epsilon_h$. Miyamoto, K. (Institute of Plasma Physics, Nagoya University, Nagoya, Japan). Phys. Fluids 17: No. 7, 1476-1477 (July 1974).

Diffusions of plasmas confined in the stellarator with $\epsilon_l > \epsilon_h$ are considered in the region of very low frequency where ϵ_l and ϵ_h are the field modulations of toroidal and helical terms. The dependence is different from the opposite case of $\epsilon_h > \epsilon_l$. (auth)

211 TWO-DIMENSIONAL GROWTH OF A BLEACHING WAVE. Rehm, R.G. (Calspan Corporation, Buffalo, New York 14221). Phys. Fluids 17: No. 7, 1473-1475 (July 1974).

An analytical solution is presented which describes the axisymmetric growth of a high-temperature region heated by laser radiation, known as a bleaching wave. Constant-temperature profiles for the wave are shown for ruby laser radiation and for CO_2 laser radiation incident upon a plasma. (auth)

212 PLASMA HEATING BY SPATIAL RESONANCE OF ALFVÉN WAVE. Chen, L.; Hasegawa, A. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Fluids 17: No. 7, 1399-1403 (July 1974).

Heating of a collisionless plasma by utilizing the spatial resonance of shear Alfvén waves is proposed and application to toroidal plasmas is discussed. The resonance exists due to the nonuniform Alfvén speed. This heating scheme is analyzed in one dimension including the effects of a shear magnetic field and plasma compressibility. For plasmas with smooth nonuniformities ($|k_1 l| \gg 1$, k_1 is the wavenumber perpendicular to the ambient magnetic field and the nonuniformity direction, and l is the scale length of the nonuniformity), the energy absorbed per unit surface area per driving cycle is $[b_0^2(\mu_0 k_1)^{-1}]$. Here, b_0 is the flux density of the driving magnetic field evaluated at the resonant point. With sharp nonuniformities ($|k_1 l| \ll 1$), absorption is large if the surface eigenmode is

excited. The corresponding value is $[b_0^2(\mu_e k_\perp)^{-1}(k_\perp l)^{-1}]$. Otherwise, it is $[b_0^2(\mu_e k_\perp)^{-1}(k_\perp l)]$. (auth)

213 INFLUENCE OF ION TAIL FORMATION AND ION RESONANCE BROADENING ON THE DYNAMICAL BEHAVIOR OF A CURRENT–CARRYING PLASMA. Caponi, M.Z.; Davidson, R.C. (Center for Theoretical Physics, Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Fluids 17: No. 7, 1394-1398 (July 1974).

The influence of ion tail formation on the dynamical behavior and anomalous resistivity of a current–carrying plasma is studied within the context of a quasilinear model that includes ion resonance broadening as a possible quasi–saturation mechanism for the ion acoustic instability. Although the detailed time development of macroscopic plasma parameters depends on n_b/n_i (the ratio of ion tail density to total ion density), the value of anomalous resistivity at quasi–saturation is found to be relatively insensitive to the formation of a low–density high–energy ion tail. For example, if $n_b/n_i = 0.2$, the anomalous resistivity is lowered by 15% relative to its value in the absence of an ion tail. (auth)

214 ION HEATING BY THE CURRENT–DRIVEN ELECTROSTATIC ION–CYCLOTRON INSTABILITY. Rynn, N.; Dakin, D.R.; Correll, D.L.; Benford, G. (Department of Physics, University of California, Irvine, California 92664). Phys. Rev. Lett. 33: No. 13, 765-768 (23 Sept 1974).

We have observed and confirmed significant ion heating by the electrostatic ion–cyclotron instability in a barium plasma. We present spectroscopic evidence showing that this mechanism drastically alters the velocity distribution, demonstrating at least a highly nonlinear process and giving strong evidence for randomization of the particle motion. Experimental corroboration of a theory of Drummond and Rosenbluth is presented. (auth)

215 EXPERIMENTAL STUDY OF THE ABSORPTION MECHANISMS OF A VERY INTENSE LASER BEAM IN THE MATTER. Saleres, A.; Cognard, D.; Redon, D.; Floux, F.; Bobin, J. L. (Centre d'Etudes de Limeil, Villeneuve-Saint-Georges, France). J. Phys. (Paris), Colloq.; No. 2, 9-13(1973). (In French).

From centenary congress of the French Physical Society; Vittel, France (28 May 1973).

Heating mechanisms of a deuterium, neodymium laser-produced plasma were investigated. Neutron emission and reflection along the axis of the laser beam with frequencies ω_0, $2\omega_0$, $3\omega_0/2$ have been sharply connected with ion expansion according to the focusing conditions by moving the surface of the target in the neighborhood of the focal point of the lens. (FR)

216 HEATING OF A DEUTERIUM PLASMA USING A MOLECULAR LASER. Rabeau, M.; Rostaing, M.; Colombant, D. (Centre d'Etudes de Limeil, Villeneuve-Saint-Georges, France). J. Phys. (Paris), Colloq.; No. 2, 5-8(1973). (In French).

From centenary congress of the French Physical Society; Vittel, France (28 May 1973).

When firing a 300 MW TEA CO_2 laser on to a solid deuterium ice, a plasma is produced. The expansion velocity is up to 4×10^7 cm/s. The ion temperature reaches 300 eV. These quantities were measured by means of a set of particle collectors and an electrostatic analyzer. The results are in fair agreement with the radiation flame model. (FR)

217 PLASMA HEATING AND THE IGNITION PROBLEM. Canobbio, E. (CEN, Grenoble, France). J. Phys. (Paris), Colloq.; No. 2, 41-47(1973).

From centenary congress of the French Physical Society; Vittel, France (28 May 1973).

The various plasma heating methods which can be used to overcome the limitations of ohmic heating in order to achieve ignition in low-β toroidal systems are discussed. The overall power balance equation of a "neoclassical" plasma is discussed without and with the addition of a given amount of supplementary power. Then attention is directed to (a) adiabatic compression, (b) neutral beam injection, and (c) slow hf-plasma interactions, leaving aside those fast processes like shocks, turbulence, intense hf-fields, relativistic electron beams, lasers, which are obviously impracticable in large energetic low-β toroidal systems. The most interesting hf heatings are, in order of increasing frequency: transit time magnetic pumping, ion cyclotron absorption (in 2 versions), and heating at the lower hybrid resonance. For each method the basic physical mechanisms involved are explained and the important aspects are pointed out. At the same time, the range of parameters in which these various methods have already been proved to work or are expected to be successful after some technological improvement is indicated. (FR)

218 NUMERICAL SOLUTIONS OF PLANE BOUNDARY-VALUE PROBLEMS OF LASER HEATING OF PLASMA WITH CONSIDERATION OF THE RECOVERED ENERGY OF NUCLEAR FUSION. Kaliski, S.; Rymarz, C.; Solarz, L.; Wlodarczyk, E. (Instytut Podstawowych Problemow Techniki, Warsaw). Proc. Vib. Probl.; 14: No. 4, 325-343(1973).

219 PLASMA PRODUCTION, HEATING, AND CONFINEMENT IN FUSION DEVICES. Bickerton, R. J.; Keen, B. E. (Culham Lab., Abingdon, Eng.). pp 243-277 of Plasma Physics. Keen, B. E. (ed.). London; Inst. of Physics (1974).

The physical conditions for thermonuclear reaction are considered from which it is deduced that the problems involved in reaching reactor conditions are plasma production, heating and containment and the design of a prototype reactor with attendant technological problems. Of the methods of containment considered, magnetic confinement of the plasma is the most attractive and is considered in detail including; magnetic mirror systems, thetatron systems, levitron devices, toroidal pinch systems, stellarator systems, and diffusion in toroidal systems. An outline is given of the main methods used to produce plasma for plasma physics and confinement research including; thermal plasma production, plasma produced by electric breakdown, plasma guns, neutral injection, and laser-produced plasmas. Methods of plasma heating are described applicable to toroidal confinement systems. There are a number of technological problems to be solved before a fusion reactor can be a practical proposition and the economic viability of a reactor will depend on the methods of solution of these problems. (UK)

220 PLASMA HEATING BY LOWER HYBRID RESONANCE. Sugawa, M.; Sugaya, R.; Nomoto, H. (Ehime Univ., Matsuyama (Japan)). Phys. Lett., A; 48: No. 6, 407-408(29 Jul 1974).

Recently, heating plasmas at a frequency near the lower hybrid frequency ω_{LH} has been of considerable interest and observed in some experiments. It is expected that the absorption of the rf field will occur near the lower hybrid resonant frequency ω_{LH} ($1/\omega_{LH}^2 = 1/\omega_{pi}^2 + 1/\omega_{ci}\omega_{ce}$). In this note it is reported that ions and electrons were heated simultaneously by the rf field at lower hybrid resonant frequency. Experimental results are presented for the dispersion relation of the resonance. (auth)

221 EVOLUTION OF THE ION DISTRIBUTION FUNCTION DURING HF HEATING AT TWICE THE ION CYCLOTRON FREQUENCY. Brambilla, M. (Centre d'Etudes Nucleaires, Centre de Tri, Grenoble, France. Dept. de Physique du Plasma et de la Fusion Controlee). Phys. Lett., A; 48: No. 6, 405-406(29 Jul 1974).

The equation governing the ion distribution function when a toroidal plasma is heated by a radiofrequency wave at $\omega = 2\Omega_{ci}$ is derived. A numerical integration of this equation shows that a suprathermal anisotropic tail develops in the distribution function, as experimentally observed on the ST Tokamak. (auth)

222 PARAMETRIC STUDY OF THE CONFINEMENT PROPERTIES OF A MAGNETIC WALL. Tran, M. Q. (Ecole Polytechnique Federale, Lausanne (Switzerland)). Phys. Lett., A; 48: No. 6, 447-448(29 Jul 1974).

Parametric measurements of the confinement properties of a magnetic wall are presented. The plasma loss to the wall is shown to present a minimum for a certain magnet spacement. No optimum was found for the fast ionizing electron confinement. (auth)

Diagnostics

Refer also to abstract 1324.

223 (AD-778449) LASER DIAGNOSTICS APPLIED TO METALLIC-ION SYSTEMS. Final Report, 1 January 1969–31 December 1973. Bach, D. R. (Michigan Univ., Ann Arbor (USA). Dept. of Nuclear Engineering). 31 Dec 1973. 25p. (AFOSR-TR-74-0681). NTIS $3.00.

Experiments involving the interaction of He–Ne (6328), ruby, and CO_2 laser light with lithium exploded wire plasmas are described. Additional experiments include spectroscopic studies, large area detector studies, dies for lithium extrusion, TEA laser construction, and preliminary holographic interferometry and x-ray ratio detection systems. (auth)

224 (CLM-R-138) ABSOLUTELY CALIBRATED X-RAY IMAGE INTENSIFIER AND HIGH-SPEED SHUTTER BASED ON A CHANNEL MULTIPLIER ARRAY FOR THE DETECTION OF RADIATION FROM HIGH-DENSITY PLASMAS. Joint European Programme on Plasma Focus. Hobby, M. G.; Rager, J. P.; Peacock, N. J. (UKAEA Research Group, Abingdon, Culham Lab.). May 1974. 11p. Dep. NTIS (US Sales Only) $4.00. UK 50 pence.

An x-ray image intensifier based on a channel multiplier array was developed to overcome the low overall sensitivity of

wavelength dispersive crystal spectrometers. A prototype instrument was absolutely calibrated on standard x-ray sources and tested on two high-density plasmas. In addition to demonstrating a sensitivity gain of the order of 100 without appreciable loss of resolution, the intensifier was successfully shuttered for times as short as 12 nanoseconds by pulsing the accelerating voltage on to the channel plate. (auth)

225 (IPP-1/146) DEVELOPMENT OF MULTICHROMATIC HOLOGRAPHIC INTERFEROMETRY IN THE 3 μm RANGE (HF LASER) AND APPLICATION TO HIGH-β STELLARATOR PLASMAS. Braun, W. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Jul 1974. 44p. (In German). Dep. NTIS (US Sales Only) $5.25.

Holographic interferometry in the 3 μm wavelength range was developed to measure density profiles in toroidal high-β plasmas. The choice of hydrogen fluoride (HF) laser (2.7 .... 3.1 μm) as a light source meets exactly the requirement of optimal sensitivity of this method within the transparent region of quartz, of which discharge tubes are usually made. Eight strong spectral lines of the HF laser can be used to produce eight superposed holograms on a gelatin detector with almost linear sensitivity by a special method. The method was first applied to investigate the density distribution in a high-β stellarator plasma. An elliptic deformation of the plasma cross section was observed. (auth)

226 (LA-5656-PR, pp 71-82) Z-PINCH PROGRAM. Jul 1974.

In LASL Controlled Thermonuclear Research Program.

The following topics are briefly discussed: (1) electron temperature by Thomson scattering, (2) electron temperatures from time-resolved spectroscopy, (3) ion temperature from Doppler broadening measurements, (4) plasma density measurements with laser interferometer, (5) derating of the ZT-1 experiment, (6) MHD stability analysis, (7) symmetric Suydam modes, and (8) crowbar spark gaps. (MOW)

227 (LBL-2014) MULTIPLE-BEAM SPECTROSCOPY. Rostler, P. S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1974. Contract W-7405-eng-48. 284p. Dep. NTIS $17.25.

Thesis.

A new spectroscopic technique is described which provides spatially localized information about fine scale fluctuations in the density of light sources within a self-luminous plasma. It is shown that the light accepted by a two-beam system can be described in terms of spatial Fourier transforms of the field. The mutual coherence between light of wave number $|k_A| = |k_B|$ emitted in directions $\hat{k}_A$ and $\hat{k}_B$ is then shown to be proportional to the $k_\Delta = k_A - k_B$ Fourier component of the light source distribution. This result is similar to what is found in an analysis of laser-light scattering. Thus the type of information given by a scattering experiment can also be obtained from spectroscopic measurements upon the light emitted by the plasma itself. Multiple-beam spectroscopy and laser-light scattering differ, however, both in applications and in basic principles, as is explained in a detailed comparison of the two methods. The final system studied was then used to observe fluctuations in a laboratory plasma. The plasma was produced in helium by an electron beam, the fluctuations were imposed upon it with a probe, and a selected wavelength and frequency component of the disturbance in the plasma was observed through measurements of fluctuations in the distributions of the sources of the strongest neutral helium emission line. The plasma phenomena observed were not extensively explored, but the results obtained show that a multiple-beam spectrometer can actually be used for plasma diagnostics. The theory developed to describe these measurements is then extended to some other cases. These include the use of higher order optical correlation measurements to detect higher order correlations in the source, the use of several optical frequencies to observe high-frequency phenomena within a plasma, and the use of a broad portion of the optical spectrum to make one observation more efficiently. (auth)

228 (ORNL-4982, pp 30-38) ATOMIC CROSS SECTIONS, PLASMA DIAGNOSTICS, AND THE CONTROLLED FUSION ATOMIC DATA CENTER. Alvarez, I.; Barnett, C. F.; Bush, C. E.; Cisneros, C.; Ray, J. A. Sep 1974.

In Thermonuclear Division annual progress report for period ending December 31, 1973.

The total and differential scattering cross sections for D^- formation when D^+, D_2^+, and D_3^+ pass through cesium vapor were measured. The scattering of D^- formed by double electron capture was less than 1° for 90% containment of the D^-. Scattering from incident D_2^+ and D_3^+ was much larger and showed structure indicative of electron capture into repulsive levels of D_2 and D_3. Measurements have been completed of the cross sections for D^- production from H_2^+, H_3^+, and HD_2^+ incident on H_2 gas in the energy range 100 to 600 keV. Cross sections decreased monotonically with energy, and the negative ion equilibrium fraction was the same as that expected for an equivalent-velocity proton passing through H_2. To aid in the interpretation of the heavy-ion probe as a plasma diagnostic technique, electron capture and loss cross sections of thallium and potassium ion beams passing through H_2 were measured. In diagnostic developments, the resolution of the ORMAK perpendicular neutral particle spectrometer has been decreased, resulting in increased counting rates and better statistics. A parallel spectrometer has been constructed and calibrated. Preliminary results obtained from a typical ORMAK plasma indicate that (1) the parallel temperature is equal to the perpendicular temperature; (2) the energy spectrum of injected neutrals shows a broad spectrum peaking between 8 and 14 keV; (3) scanning across the horizontal plane of ORMAK indicated a flat density profile for the Maxwellian plasma. During the year, improvements have been made on the pyroelectric bolometer which is to be used to measure energy flow from the ORMAK plasma. (auth)

229 (UCID-15767) DENSITY MEASUREMENTS IN THE SCL USING A NEUTRAL BEAM. Hooper, E. B. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1970. 13p. Dep. NTIS $4.00.

The use of a neutral lithium beam for probing a hydrogen plasma in the SCL is analyzed. A 10-nA-equivalent beam and an amplifier response time of 10 μsec should permit measurements of $10^{11} < n < 7 \times 10^{13}$ cm^{-3} with 10% accuracy. The maximum permitted background gas pressure ranges from 1.5×10^{-4} torr at $n = 10^{11}$ cm^{-3} to 10^{-1} torr at 7×10^{13} cm^{-3}. (auth)

230 (UCID-16115) SHIELDED DIAMAGNETIC PROBES FOR PULSED MAGNETIC FIELD MEASUREMENTS. Fessenden, T. J.; Stallard, B. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Aug 1972. 17p. Dep. NTIS $4.00.

The theory is given for magnetic probes that can be used for measuring pulsed magnetic fields. It is shown that by proper design probes having rise times of approximately 10 nsec with reasonable sensitivity can be constructed. A description of the two types of magnetic probes presently in use in the ASTRON experiment is given. (auth)

231 DETERMINATION OF THE ELECTRON VELOCITY DISTRIBUTION FUNCTION BY THE THOMPSON SCATTERING METHOD. Zhuravlev, V. A.; Petrov, G. D.; Yurchuk, E. F. (All-Union Scientific Research Inst. of Physical-Technical and Radiotechnical Measurements, Moscow). Zh. Eksp. Teor. Fiz.; 66: No. 5, 1622-1625(May 1974). (In Russian).

It is demonstrated that the electron velocity distribution function can be determined by inverting the incoherent Thompson scattering indicatrix and spectrum. Calculation formulas are proposed for low-temperature and relativistic plasmas. (auth)

232 DETERMINATION OF DENSITY AND TEMPERATURE OF A PLASMA FROM THE ABSORPTION OF γ AND β RADIATION. Ulanov, I. M. (Inst. of Thermal Physics, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Tekh. Nauk; No. 8, 33-38 (Jun 1974). (In Russian).

For determining density, ^{55}Fe sources are used at argon plasma pressures up to 10 atm, with a plasma column length of 10 cm, since with a further increases in pressure its radiation is almost completely absorbed. This source is used for translucence of a nitrogen plasma at pressures of the order of 100 atm since in nitrogen the mass coefficient of attenuation is significantly lower than in argon. ^{57}Co, ^{147}Pm, and ^{144}Ce may be used in the radioscopy of an argon plasma at 100 atm pressure, a nitrogen plasma at 50 atm and higher, with a 10-cm length of the luminescent part. A ^{90}Sr source is used for measuring the density of a plasma of any chemical composition at pressures of 1 to 200 atm and a luminescent section about 10 cm long. The source activity should be 1 Ci. All sources mentioned emit only β or soft γ radiation, and therefore protection from the radiation is simple and reliable. Lead glass 1 to 2 cm thick is sufficient. (tr-auth)

233 N^- ION CONTRIBUTION TO THE CONTINUOUS EMISSION OF A NITROGEN PLASMA AT 4955 A. Fauchais, P.; Baronnet, J. M.; Bayard, S.; Andres, F. (Univ., Limoges, France). J. Phys. (Paris), Colloq.; No. 2, 137-143(1973). (In French).

From centenary congress of the French Physical Society; Vittel, France (28 May 1973).

In a nitrogen plasma at atmospheric pressure the continuum radiation measured in the visible is higher than the contributions from positive ions. Measurements done at 4955 A, region where the continuum is perfectly well defined (no atomic or molecular spectra in the neighborhood), seems to show that between 8000 and 14000°K the contribution of negative ion N^- has to be considered.

This permits, in the LTE, to deduce, from the continuum measurements, temperature similar to those obtained from atomic and molecular spectra. (FR)

234 "PRESSURE" BALANCE IN PULSED PLASMAS WITH LARGE SELF-FIELDS. Hammer, D.A. (University of Maryland, College Park, Maryland 20742). Phys. Fluids 17: No. 6, 1260-1262 (June 1974).

Momentum and flux conservation laws are combined for a cylindrically symmetric magnetically confined, pulsed electron beam (or plasma) to obtain a generalized "pressure balance" equation. This equation is useful for interpretation of magnetic probe signals in intense electron beam experiments, in which large self-electric and magnetic fields are present. (auth)

235 CORRELATION OF SOFT X-RAY SPOTS WITH HARD RADIATION AND NEUTRON EMISSION IN A 1-kJ PLASMA FOCUS. Schönbach, K.H.; Michel, L.; Fischer, H. (Applied Physics, Technische Hochschule Darmstadt, Federal Republic of Germany). Appl. Phys. Lett. 25: No. 10, 547-549 (15 Nov 1974).

One to four x-ray spots are always present in hydrogen and deuterium along the z axis during the dense pinch phase; ~4% argon is required for pinhole photography. Spots have an observed 5-10-ns lifetime and develop in succession within the first 30 ns of the x-ray emission. The hard >80-keV radiation shows the spot time structure and controls the neutron pulse. The x-ray spots represent m=0 plasma instabilities. (auth)

236 EFFECT OF INITIAL ION VELOCITIES ON THE THICKNESS OF A PLANAR SHEATH. Oliver, B.M.; Clements, R.M. (University of Victoria, Victoria, British Columbia, Canada V8W 2Y2). Phys. Fluids 17: No. 7, 1478-1479 (July 1974).

A straightforward method is presented for calculating the sheath thickness surrounding a planar probe in a collisionless plasma assuming an initial ion velocity. Sheath thicknesses are compared to those calculated from Langmuir's modified planar analysis. (auth)

237 STUDY OF THE POPULATION OF THE ION EXCITED STATES IN A DENSE PLASMA FROM X-UV ADSORPTION MEASUREMENTS. Carillon, A.; Jaegle, P.; Sureau, A.; Jamelot, G. (Univ., Paris). J. Phys. (Paris), Colloq.; No. 2, 117-121(1973). (In French).

From centenary congress of the French Physical Society; Vittel, France (28 May 1973).

The study of transfer radiation equation through a plasma, by taking into account spontaneous emission absorption and stimulated emission processes allows the interpretation of the absorption data obtained in the x-uv range for a dense plasma. Then, the population of the excited states of ions can be calculated. For the $2p^5 4d^3P_1^0 \rightarrow 2p^6\ ^1S_0$ transition located at 117.410 A, the higher level reveals to be overpopulated and this overpopulation is close to inversion with respect to the ground level. (FR)

238 DETERMINATION OF THE TEMPERATURE OF N_2 AND N_2^+ MOLECULES IN A NITROGEN PLASMA PRODUCED WITH AN ARC GENERATOR. Baronnet, J. M.; Fauchais, P.; Bayard, S. (Univ., Limoges, France). J. Phys. (Paris), Colloq.; No. 2, 129-135(1973). (In French).

From centenary congress of the French Physical Society; Vittel, France (28 May 1973).

To reach the N_2 and N_2^+ molecules rotational-vibrational temperature in a nitrogen arc plasma at atmospheric pressure, the $(1^-)N_2^+$ and $(2^+)N_2$ spectra intensities for the temperature range 5000 to 12,000 K have been measured. Above 8000 K, LTE is verified but below this temperature, some discrepancies between the experimental intensities of these two systems and the intensities of these systems calculated in the LTE hypothesis are observed. The vibrational level $\nu = 0$ population of the $C^3PI_u N_2$ state excited by the argon metastables, has showed that the rotational levels population is Maxwell distributed; therefore, we can obtain a rotational temperature and the overpopulation of the $\nu = 0$ level. (FR)

239 PROBE MEASUREMENTS. Allen, J. E. (Oxford Univ.). pp 131-144 of Plasma Physics. Keen, B. E. (ed.). London; Inst. of Physics (1974).

The technique of probe measurement consists of inserting a small electrode into the plasma and measuring the current as a function of the applied voltage. The voltage is measured with respect to some convenient reference point, often the cathode of the discharge. The classical theory of Langmuir, the Tonks-Langmuir theory of the positive column, the Bohm criterion for sheath formation, and the theory of the spherical probe are discussed. The sources of error in probe measurement are listed. Attention is drawn to the method of probing with dynamic sheaths. (UK)

240 OPTICAL METHODS OF PLASMA DIAGNOSTICS. Evans, D. E. (Culham Lab., Abingdon, Eng.). pp 145-176 of Plasma Physics. Keen, B. E. (ed.). London; Inst. of Physics (1974).

Information about a plasma can be deduced from radiation generated within it and emitted, or from the changes undergone by radiation introduced into the plasma but derived from an independent source. Measurements of the first kind constitute emission spectroscopy while those of the second kind embrace interferometry and scattering. These methods are discussed. Phenomena arising from light transmitted through the plasma giving rise to coherent scattering processes and light scattered by the plasma, that is incoherent scattering, are considered. Laser light scattering is thought to be the most powerful and versatile plasma diagnostic tool available and this method is discussed with respect to the dynamic form factor, the dispersion relation for waves in plasma, the electron feature, the ion feature, the effect of drift current, the effect of impurity ions, and the effect of uniform, stationary magnetic fields. It is concluded that collective effects can be observed when scattering lengths exceed Debye length and the increasingly long scale lengths necessary to match Debye lengths in plasmas of current interest in fusion research can only be reached by using lasers of longer wavelength than that of the familiar Q-switched ruby, or very small scattering angles. (UK)

Kinetics (General)

241 (AD-773765) CALORIMETER FOR SOFT X-RAY PLASMA SOURCES. Technical Report, September 1971-Mar 1972. Burns, E. J. T. (Air Force Weapons Lab., Kirtland AFB, N. Mex. (USA)). Jan 1974. 20p. (AFWL-TR-73-192). NTIS $3.00.

A calorimeter for soft x-ray plasma sources is discussed in theory, design, and operation. The receivers are metallic and are limited to radiation above 60 eV in a windowless mode. The absorbed radiant energy is transferred by means of a bimetallic thermocouple junction, which in turn is analyzed on a standard microvoltmeter. (auth)

242 (AD-777442) INVESTIGATING A QUASI-UNIDIMENSIONAL MODEL OF A GAS DISCHARGE CONTRACTION. Vitshas, A. F.; Dykhne, A. M.; Naumov, V. G.; Panchenko, V. P. Translated from Teplofiz. Vys. Temp.; 9: No. 2, 225-229(1971). 10p. (NISC-TRANS-3487). NTIS $4.00.

Theoretical investigations were made of a heat construction model of low-temperature plasma for the case of plane geometry discharge. (auth)

243 (AD-777721) DEPARTURE FROM LTE (LOCAL THERMODYNAMIC EQUILIBRIUM) IN AN OXYGEN PLASMA. II. Collisional-Radiative Model. Julienne, P. S.; Davis, J.; Hyman, E. (Naval Research Lab., Washington, D. C. (USA)). Mar 1974. 36p. (NRL-MR-2740). NTIS $3.25.

A collisional-radiative model of a decaying oxygen plasma was constructed in order to characterize the visible and infrared emission as a function of electron density and temperature. All collisional and radiative processes affecting the population of the oxygen levels up to principal quantum number 18 are included in the model. Some results are given. (auth)

244 (COO-3086-29) NUMERICAL SOLUTION OF SHOCK TUBE DIVERTOR AND RELATIVISTIC ELECTRON BEAM VACUUM FIELDS. Report No. 64. Todd, A. M. M. (Columbia Univ., New York (USA). Plasma Lab.). 1974. Contract AT(11-1)-3096. 36p. Dep. NTIS $5.00.

Vacuum field solutions for the $r-\theta$ plane magnetic field of a shock tube divertor and the $r-z$ plane electric field in the diode of a relativistic electron beam generator are presented. The solutions were obtained using an overrelaxation code, and show the variation of separatrix position with geometry and divertor to center conductor current ratio, and the dependence of the diode capacitance on geometry. (auth)

245 (LA-tr-74-32) INVESTIGATION OF FAST MAGNETIC PLASMA COMPRESSION AS METHOD FOR GENERATING HIGH TEMPERATURES WITH WEAK COMPRESSION. Soeldner, F. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F.R. Germany)). Jan. 1974. Translation of IPP-1/141. 56p. Dep. NTIS $6.00.

The fast magnetic compression of a low density plasma ($n_0 \approx 2 \times 10^{13}$ cm^{-3}) and its moving into equilibrium are investigated in a high voltage theta pinch ($U_{0,max}$ = 500 kV). Electron density and temperature are measured by ruby laser light scattering. Ions are reflected from the magnetic piston during compression (about 30% reflection degree) resulting in strong ion heating. The magnetic piston is finally stopped by the kinetic pressure of the compressed plasma and a $\beta \approx 1$-plasma core is formed ($n_e \approx 4 \times 10^{14}$ cm^{-3}, $T_e \approx 25$ eV, $T_i \approx 3$ keV). This plasma core is surrounded by a hot

low density plasma mantle caused by flute instabilities which develop during the compression. Currents in this halo plasma partly screen the inner plasma column from the vacuum field and the weakened field at the edge of the core acts as an effective magnetic piston field. Plasma simulation calculations carried out with this effective field show good agreement with the experiment. A compression ratio of x ($\beta = 0.5$) $\approx$ 1.8 is reached. According to theory a stable toroidal plasma confinement should be possible for $x \leq 2$. But the stability of a plasma with diffuse profile as caused by flute instabilities in the above experiment has not yet been clarified. (auth)

246 ELECTROLYTIC CAPACITOR POWER SOURCE DESIGN FOR QUASI-STEADY MAGNETOPLASMADYNAMIC ARCS. Di Capua, M. S.; Kurtz, H. (Univ., Stuttgart). J. Spacecraft Rockets; 11: No. 8, 554-559(Aug 1974).

An "LC-Ladder" network is investigated theoretically and experimentally to determine the effect of the capacitor series resistance R_C and the inductor series resistance R_L on the shape of the current pulse, on the efficiency of energy transfer, and on the weight of the thruster system. R_C increases the risetime, decreases the duration of the constant current phase, and extends the pulse tail. The deterioration of the pulse is caused by energy dissipation within the network. A small ratio of R_C to the impedance of the network Z_0 minimizes this loss. R_L causes a decay of the constant current phase and significant energy losses within the network. The number of elements in the network, multiplied by the ratio R_L to Z_0, must be small to minimize this loss. These losses imply an increased primary power source mass. However, there is a tradeoff between inductor mass (to minimize R_L) and primary power source mass. (auth)

247 ENERGY CHARACTERISTICS OF A PULSED COAXIAL PLASMA ACCELERATOR. Kalmykov, A. A.; Timofeev, A. D.; Shevchuk, B. A. (Physical-Technical Inst., Kharkov). Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 12, 1601-1603 (Jun 1974).

Translated from Zh. Tekh. Fiz.; 43: No. 12, 2547-2552(Dec 1973).

The basic discharge characteristics were measured for two sets of operating conditions in a pulsed coaxial plasma accelerator, i.e., "fast" conditions, characterized by the production of high-energy ions, and "slow" conditions, characterized by the production of slow plasma streams. The energy input into the discharge and the distribution of this energy among the various components are calculated from the measured total current, input voltage, and output voltage through the use of an equivalent electric circuit. It is found that fast conditions are characterized by an anomalous resistance and the predominant expenditure of energy in ohmic heating of the plasma. (auth)

248 EFFECT OF THE DIFFUSION OF ELECTRONS ON THE DISTRIBUTION FUNCTION AND ENERGY BALANCE OF ELECTRONS IN A HELIUM AFTERGLOW. Monchicourt, P.; Touzeau, M.; Wells, W. E. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 2, 145-149(1973). (In French).

From centenary congress of the French Physical Society; Vittel, France (28 May 1973).

The de-excitation of metastable atoms and molecules in the afterglow of a weakly ionized helium gas leads to the creation of the hot electrons having energies of between 15 and 20 eV. The energy relaxation of these electrons was studied under conditions where the diffusion is not negligible. The expression for the coefficient of diffusion together with considerations on the space charge created by the total electron energy distribution enables calculations to be made of the number of electrons disappearing during the relaxation process and the perturbation resulting in the Maxwellian distribution. The importance of this effect is given for some particular experimental cases. (FR)

249 INTENSITIES OF ZEEMANN COMPONENTS OF QUADRUPOLE LINES IN PLASMA. Kleiman, E. B.; Oiringel, I. M. (Gorky State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 7, 939-943(1974). (In Russian).

The intensities of different Zeemann components of quadrupole lines were calculated for an atom being in a magnetoactive plasma. It is shown that the plasma medium may influence the radiation polarization. (auth)

250 STATISTICAL MECHANICS OF "NEGATIVE TEMPERATURE" STATES. Montgomery, D.; Joyce, G. (Department of Physics and Astronomy, The University of Iowa, Iowa City, Iowa 52242). Phys. Fluids 17: No. 6, 1139-1145 (June 1974).

The dynamics of two-dimensional interacting "line" vortices is identical to that of the two-dimensional electrostatic guiding center plasma. Both are Hamiltonian systems and are therefore susceptible to statistical mechanical treatments. The predictions of the microcanonical ensemble are explored for this system. Interest focuses primarily on the regime in which the interaction energy is high enough to be above the Onsager "negative temperature" threshold. Calculations of the probability distribution for a component, by means of the central limit theorem, are carried out in the manner of Khinchin. The probability distribution of a component reduces to the usual Gibbs distribution in the regime of positive temperatures, and is still explicitly calculable for negative temperatures. The negative temperature states are neither quiescent nor spatially uniform. Expressions for the temperature are explicitly provided in terms of the total particle energy and particle number. A BBGKY hierarchy can be derived for both temperature regimes. A Vlasov approximation on the first pair of BBGKY equations leads to the differential equation (two dimensions) $\nabla^2\psi + \sinh\psi = 0$. The charge (vortex) density has an expectation value proportional to $\nabla^2\psi$. Numerical simulations involving solutions of the equations of motion of 4008 particles are presented. (auth)

251 EXCITATION TRANSFER IN ARGON-NITROGEN MIXTURES. Deschamps, J.; Ricard, A. (Univ., Paris). J. Phys. (Paris), Colloq.; No. 2, 123-128(1973). (In French).

From centenary congress of the French Physical Society; Vittel, France (28 May 1973).

The excitation transfer between metastable argon atoms and nitrogen molecules in the positive column of a glow discharge were studied. The excitation cross sections of nitrogen by argon metastables were deduced from diagnostics of metastables by optical absorption, the measurement of electrons densities by a microwave cavity method, and the determination of the electron temperature by Langmuir probes. For the three levels $^3P_2$, $^3P_1$ and $^1P_1$, the cross sections values are 2 ($\pm$ 1) $\times 10^{-16}$ cm^2 in agreement with published values. For the $^3P_0$ level, the measured value of 3.5 ($\pm$ 1.3) $\times 10^{-17}$ cm^2 appears to be the first published experimental value. The observation of the N_2 second positive spectrum indicates that metastable argon atoms excite to the $N_2(C^3\Pi_u)$ state on the vibrational level $\nu' = 0$ and the rotational levels $J' \leq 55$. (FR)

252 RADIATIVE LIFETIME OF THE $d^3\Pi_g$ STATE OF EXCITED C_2 MOLECULE IN A LASER-PRODUCED PLASMA. Velghe, M.; Leach, S. (CNRS, Orsay, France). J. Phys. (Paris), Colloq.; No. 2, 111-116(1973). (In French).

From centenary congress of the French Physical Society; Vittel, France (28 May 1973).

Electronically excited C_2 molecules are formed by laser-pyrolysis, i.e., through focusing a Q-switched ruby laser beam on a graphite target in a vacuum. A study of the time evolution of the emission intensity of the (0,0) band of the $d^3\Pi_g \rightarrow a^3\Pi_u$ transition of C_2 led to a value of $\tau(0,0) = 220 \pm 20$ ns for the lifetime of the $d^3\Pi_g$ ($\nu = 0$) vibronic level. A comparison is made with other results by laser pyrolysis and by phase-shift techniques. (FR)

253 EFFECT OF AN INFRARED LASER RADIATION ON THE SPECTRAL LINES EMITTED FROM A LOW PRESSURE HYDROGEN DISCHARGE. Dubreuil, B.; Chapelle, J. (Orleans Univ., France). J. Phys. (Paris), Colloq.; No. 2, 105-109(1973). (In French).

From centenary congress of the French Physical Society; Vittel, France (28 May 1973).

When a continuous CO_2 laser beam is focused on a capillary hydrogen discharge, two effects appear on the emitted Balmer lines; on the one hand the shift of these lines due to virtual interaction between hydrogen excited atoms and laser photons with a large shift for Hδ line; on the other hand the lowering of spectral lines intensities which is explained as photoionization from highly excited levels ($n > 10$); a theoretical interpretation is done in the two cases. (FR)

254 PLASMA PHYSICS. Lectures from the Culham Plasma Physics Summer Schools, Held at Abingdon, England. Keen, B. E. (ed.). Institute of Physics Conference Series, No. 20. London; Institute of Physics (1974). 339p. £15.

Separate abstracts were prepared for the 13 lectures presented at the Plasma Physics Summer Schools. (UK)

255 INTRODUCTION TO PLASMA PHYSICS. Watson, C. J. H. (Culham Lab., Abingdon, Eng.). pp 1-20 of Plasma Physics. Keen, B. E. (ed.). London; Inst. of Physics (1974).

An historical introduction to plasma physics is followed by a survey of plasmas which are found in nature. Plasma kinetic theory and plasma properties including low-energy-density/high energy-flux, quasi-neutrality and its breakdown, dc conductivity, ac dielectric properties, magnetic properties, and plasma memory are discussed. Some applications, uses and misuses of plasma physics are listed. (UK)

Kinetics (Experimental)

Refer also to abstract 196.

256 (RISO-M-1739) EXPERIMENTAL INVESTIGATION OF PLASMAS IN A Q-MACHINE. Petersen, P. I. (Danish Atomic Energy Commission, Risoe. Research Establishment). Aug 1974. 67p. Dep. NTIS (US Sales Only) $6.50.

After a short introduction, a theoretical discussion is given on collisionless damping of ion acoustic waves in the case where the derivative of the undisturbed velocity distribution function at the phase velocity equals zero. The Q-machine and the preliminary results of the experiments on electron heating are described. Turbulence in a plasma is treated on the basis of dimensional arguments together with an experiment on turbulence in a cusp Q-device in the next section. In the last section a simple theoretical derivation is given of the Farley instability and a description of the first experimental investigation of this instability in a laboratory. (auth)

257 (WASH-1286) APPLICATION OF HIGH CURRENT RELATIVISTIC ELECTRON BEAMS IN CONTROLLED THERMONUCLEAR RESEARCH. (USAEC Division of Controlled Thermonuclear Research, Washington, D. C.). 1974. 21p. Dep. NTIS $4.00. GPO $0.75.

The technology is reviewed for intense electron accelerators for these concepts as being less demanding and more available than that for inertial confinement. However, one can identify several obvious technological problem areas which should be addressed immediately: (1) long and short-pulse diode concepts and (2) alternate energy storage concepts, particularly inductive storage and elimination of pulse lines. (MOW)

258 EFFECT OF COLLISIONS ON THE PLASMA LINE OF THE ELECTRON DENSITY FLUCTUATION SPECTRUM. Swift, D.W. (Geophysical Institute, University of Alaska, Fairbanks, Alaska 99701). Phys. Fluids 17: No. 6, 1240-1248 (June 1974).

The Klimontovich–Dupree formalism is used to investigate the effect of electron–neutral collisions on the plasma line of the electron density fluctuation spectrum. The Fourier transform of the fluctuation electron number density is calculated by integrating along electron trajectories consisting of straight–line segments joined at electron–neutral scattering sites. It is shown that the scattering process itself results in the excitation of plasma oscillations and contributes to the plasma line intensity. The electron density autocorrelation is calculated by ensemble averaging over the initial positions and velocities of all the electrons in the system and averaging over a transition probability describing the electron–neutral collisions. The transition probability is expanded as a power series in the collision frequency. The plasma line spectrum is calculated in the limit that the electron travels many wavelengths between collisions. The principal result of this is that collisions enhance the intensity of the plasma line by as much as a factor of six when the collision frequency exceeds the Landau damping decrement. This result is of most interest in attempts to observe the electron plasma line with the incoherent–scatter radar in the E–region of the ionosphere when the electron density is enhanced by auroral bombardment. (auth)

259 EXPERIMENTAL DETERMINATION OF THE RATE OF SLOWING OF FAST IONS IN A DENSE PLASMA IN A MAGNETIC FIELD. Burke, R.J.; Post, R.F. (Lawrence Livermore Laboratory, Livermore, California 94550). Phys. Fluids 17: No. 7, 1422-1427 (July 1974).

An experiment to measure the energy loss rate of fast ions moving in a dense magnetized plasma is described. In the experiment, proton and deuteron test particles lose energy predominantly to plasma electrons of comparable thermal speed. Interaction of the test particles with the plasma is limited to a defined path between two charge changing reactions. The time of interaction is determined from the cyclotron frequency of the test ions and the entrance and exit angles of the test particles. The observed energy losses are compared to the Spitzer formula and to more recent theoretical calculations. It is concluded that the Spitzer formula underestimates the energy loss by about a factor of 2; the disagreement with the more recent calculations amounts to about a factor of 3. It is proposed that the observed discrepancies may arise from cooperative particle–wave energy transport effects in the magnetized plasma. (auth)

260 EXPERIMENTAL OBSERVATION OF T LAYERS IN A MOVING PLASMA INTERACTING WITH A MAGNETIC FIELD. Zakharov, A. I.; Klavdiev, V. V.; Pis'mennyi, V. D.; Rothardt, L.; Saenko, V. B.; Starostin, A. N.; Jahn, G. (Scientific-Research Inst. of Nuclear Physics, Moscow). Sov. Phys.–Dokl. (Engl. Transl.); 18: No. 10, 657-659(Apr 1974).

Translated from Dokl. Akad. Nauk SSSR; 212: No. 5, 1092-1095(Oct 1973).

It was shown earlier that in a plasma moving across a magnetic field, instabilities can develop which are connected with local heating and which lead to the formation of structures (T layers). An experiment was undertaken in order to discover and study the conditions for the development of a series of self-propagating T layers. The plasma source (theta pinch) was separated from the dynamic plasma accelerator and a plasma cluster having known properties was injected into it. The voltage on the accelerator was turned on after a controlled time delay τ_d relative to the start of the current in the injector, sufficient for penetration into the interrail space, while the magnetic field of the accelerator retarded the movement of the cluster. Measurements of space–time distribution of plasma temperatures are described. (MOW)

Kinetics (Theoretical)

261 (COO-3077-52) EQUILIBRIA AND ADIABATIC COMPRESSION OF FREE BOUNDARY BELT PINCHES. Kadish, A.; Stevens, D. C. (New York Univ., N. Y. (USA). Courant Inst. of Mathematical Sciences). May 1974. Contract AT(11-1)-3077. 33p. (MF-78). Dep. NTIS $4.75.

The plasma shape and location of a sharp boundary belt pinch is determined by the determined by the dimensions of the surrounding conducting shell and by thermodynamic parameters. It is shown that, except for simple scaling, there exists a one-parameter family of equilibria. The plasma shape is uniquely determined by initial parameters and wall current. The variation of the plasma shape during an adiabatic compression is calculated as are plasma current, temperature, field strength, etc. As the compression ratio of the plasma is increased beyond two, the ratio of plasma height/width decreases to unity. For high compression ratios, the column cross section becomes circular. Explicit solutions are obtained by conformal mapping. (auth)

262 (LA-5656-PR, pp 83-103) THEORETICAL PHYSICS PROGRAM. Jul 1974.

In LASL Controlled Thermonuclear Research Program.

During the reporting year, the theoretical group has concentrated its efforts into three broad areas of research. The first major research area provides theoretical support to the Scyllac toroidal theta pinch program. The second area of research is numerical simulation of Vlasov plasmas and computer applications. The third area covers theoretical support for the toroidal dynamic Z pinch and related studies. (MOW)

263 (LA-tr-74-31) NUMERICAL PARAMETER STUDIES FOR PLASMA FOCUS. Trunk, M. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Plasmaforschung). 1974. Translation of IPF-73-2. 80p. Dep. NTIS $7.00.

The following topics are discussed: (1) development of the focus machine from the z-pinch machines, (2) focus discharge processes, (3) numerical calculation of the focus discharge, (4) development of the MHD basic equations for the focus geometry, and (5) Lax–Wendroff integral procedure—numerical stability. Some numerical results are also presented. (MOW)

264 (UCID-15951) SOLENOIDAL "MATCHING" FIELD FOR RELATIVISTIC BEAM INJECTION. Lee, E. P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 Nov 1971. 6p. Dep. NTIS $4.00.

When a high quality, relativistic electron beam enters a plasma channel from vacuum, it is important that it be matched to its equilibrium radius. To self-match it is necessary that the particle adiabatic invariant be conserved while the pulse finds its final equilibrium shape. It is proposed that the self-matching process is aided by the addition of a solenoidal (B_z) field centered on the beam axis and extending into the plasma for a short distance. The beam passes the entrance foil with small radius and expands slowly to its equilibrium radius in the B_z field. The theory is described. (MOW)

265 (UCID-16594) ELECTROMAGNETICALLY INDUCED PLASMA BACK CURRENT NEAR THE HEAD OF A RELATIVISTIC ELECTRON BEAM ENTERING GAS. Briggs, R. J.; Lauer, E. J.; Lee, E. P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Sep 1974. Contract W-7405-eng-48. 18p. Dep. NTIS $4.00.

The dynamics of a self-focused relativistic beam entering unionized gas are strongly dependent on the initial rate of generation of conductivity. This conductivity generation is important in determining the stability of the beam to transverse (hose) modes, and it also enters into the self-focusing of the beam by its influence on the generation of back plasma currents. A simple theoretical description is presented of the influence of the conductivity generation near the beam head on the plasma back current. Diagnostic techniques for measuring the beam and plasma currents at different axial locations are developed. (auth)

266 CRITICAL REGIME OF A PLASMA ACCELERATOR. Baksht, F. G.; Moizhes, B. Ya.; Rybakov, A. B. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 12, 1613-1616(Jun 1974).

Translated from Zh. Tekh. Fiz.; 43: No. 12, 2568-2573(Dec 1973).

The voltage–current characteristic of a crossed-field plasma accelerator is characterized by a limiting current. An explanation is offered for this limiting current (the critical regime). The transition to the critical regime is attributed to the appearance of a voltage which accelerates electrons in the anode fall. Approximate calculations are reported for the plasma flow in the narrow channel of a coaxial accelerator with a self-magnetic field and in an accelerator with an external magnetic field. (auth)

267 FIELD OF A TEST CHARGE IN AN ANISOTROPIC PLASMA. Gupta, M. R. (Univ. of Calcutta). Indian J. Phys.; 48: No. 4, 306-310(Apr 1974).

The field of a test charge was determined correct to second order in the anisotropy parameter and comparison was made with previous results. (auth)

268 RADIATION FROM A CIRCULAR WAVEGUIDE IN ANISOTROPIC PLASMA. Smirnov, E. P.; Yablochkin, N. A. (Moscow Physical-Technical Inst.). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 7, 944-949(1974).

The problem of radiation from a circular waveguide opening with an infinite perfectly conducting flange covered with a stratified anisotropic plasma of the finite thickness is solved. The external electric field corresponding to TM- and TE-waves is assumed to be given in the waveguide opening. The scalar functions being the generalization of the Debye potentials are introduced to represent the electromagnetic field in a far zone. (auth)

269 ENERGY DISTRIBUTION OF ELECTRONS IN A WEAKLY IONIZED CURRENT-CARRYING PLASMA WITH TRANSVERSE INHOMOGENEITY. Tsendin, L. D. (Leningrad Polytechnical Inst.). Zh. Eksp. Teor. Fiz.; 66: No. 5, 1638-1650(May 1974). (In Russian).

The kinetic equation was solved and the electron energy distribution function found for a weakly ionized plasma located in an external homogeneous electric field E_z, the plasma being inhomogeneous in a direction perpendicular to the current. If the size of the inhomogeneity R exceeds the electron energy relaxation length $\lambda_T = \lambda/\delta^{1/2}$ (λ is the electron mean free path, δ is the fraction of energy expended in an elastic collision), the effect of the transverse electric field on the distribution function will be small. This effect leads to the appearance of a transverse energy flux $\sim nD_e T/R$ where D_e is the electron diffusion coefficient, T is the electron temperature (mean energy) which in this case depends on the transverse coordinate. However, if $R \ll \lambda_T$ the distribution function becomes nonlocal and its shape is determined by the complete transverse profile of the potential $\varphi(x, y)$, the energy $\epsilon = mv^2/2 + e\varphi(x, y)$ being the argument. The relation between the concentration n and φ is not of the form $n \sim e^{-e\varphi/T}$ in this case and hence the ambipolar diffusion equation is significantly nonlinear. The influence of nonlocalizability on the shape of the distribution function tail is considered. (auth)

270 CORRELATION–FUNCTION METHOD FOR THE EVALUATION OF PLASMA TRANSPORT COEFFICIENTS: THE SHEAR VISCOSITY COEFFICIENT. Bartis, J.T. (Department of Chemistry, Cornell University, Ithaca, New York 14850); Oppenheim, I. Phys. Rev. A 10: No. 4, 1263-1271 (Oct 1974).

The density dependence of the viscosity coefficient of a dilute, fully–ionized plasma is obtained. We associate the viscosity coefficient η with the autocorrelation function of the off–diagonal elements of the stress tensor. The technique used is essentially equivalent to that used in a previous paper by the authors. The result of our analysis is $\eta = \Sigma_{m=1}^{\infty} U_m(T)(\ln\rho)^{-m}$, where the $U_m(T)$ are the solutions to well–defined algebraic equations. If one Sonine polynomial is used, the shear viscosity is given by $\eta = [d_1(T) \ln\rho + d_2(T)]^{-1}$. (auth)

271 COMPUTER SIMULATED FINITE–LENGTH TURBULENT HEATING EXPERIMENT. Jones, W.W.; Krall, N.A.; Klein, H.H. (University of Maryland, Department of Physics and Astronomy, College Park, Maryland 20742). Phys. Fluids 17: No. 6, 1236-1239 (June 1974).

A computer code has been used which was designed to allow for finite length effects found in real plasmas in order to study turbulent heating in a plasma where boundary conditions might be important. An electric field was applied to an initially quiescent plasma, and it was found that the final energy distribution (after saturation occurs) favors ions and electrons equally ($T_i \simeq T_e$). This is in contrast to the infinite length simulations where the electrons become much hotter than the ions $T_i \simeq (m_e/m_i)^{1/3} T_e$. It was also found that the saturation level depends critically upon the length of the system as well as the mass of the ions and the applied electric field. (auth)

272 SYNCHROTRON RADIATION SPECTRUM FOR AN INTENSE RELATIVISTIC ELECTRON RING. Davidson, R.C.; Mahajan, S.M.; Schwartz, M.J. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Fluids 17: No. 6, P1287-1290 (June 1974).

The synchrotron emission spectrum is calculated for a thin, mirror–confined, relativistic electron ring including self–field effects. Since individual electrons execute betatron oscillations about a mean radius R_0, the single–particle emission spectrum is modified from the conventional (Schott–Trubnikov) result. The spectrum of radiation emitted by all electrons in the ring is obtained by averaging the single–particle spectrum over the distribution function, $f^0_e(H, P_\theta)$, that self–consistently generates the ring equilibrium. (auth)

273 DEGREE OF IONIZATION OF A HIGH–TEMPERATURE PLASMA. Hyman, H.A. (Avco–Everett Research Laboratory, Incorporated, 2385 Revere Beach Parkway, Everett, Massachusetts 02149). Appl. Phys. Lett. 25: No. 10, 553-555 (15 Nov 1974).

An approximate method, originally proposed by Raizer for solving the Saha equations, is extended to both the corona limit, as well as to the more general, non–LTE case, in which both radiative and collisional recombination are important. The method should be useful for obtaining a reliable estimate of the degree of ionization of high–temperature high–Z plasmas. (auth)

274 CONTINUOUS SPECTRA OF A CYLINDRICAL MAGNETOHYDRODYNAMIC EQUILIBRIUM. Appert, K.; Gruber, R. (Centre de Recherches en Physique des Plasmas, Ecole Polytechnique Fédérale, CH–1007 Lausanne, Switzerland); Vaclavik, J. Phys. Fluids 17: No. 7, 1471-1472 (July 1974).

It is shown that, for a cylindrical equilibrium of a perfectly conducting plasma, the magnetohydrodynamic spectrum contains at most two continua. (auth)

275 TRANSPORT THEORY OF PLASMA. Haines, M. G. (Imperial Coll. of Science and Tech., London). pp 177-195 of Plasma Physics. Keen, B. E. (ed.). London; Inst. of Physics (1974).

The transport theory for a fully ionized gas using the method of irreversible thermodynamics is considered. Transport in a magnetized plasma with respect to the Nernst effect, the Hall effect, and the stress tensor in a magnetic field, finite ion Larmor radius effects, is discussed. Binary Coulomb collisions and the relaxation time method in elementary collisional theory are considered. (UK)

276 COMPUTATIONAL PLASMA PHYSICS. Laing, E. W. (Univ. of Glasgow). pp 279-294 of Plasma Physics. Keen, B. E. (ed.). London; Inst. of Physics (1974).

Computational plasma physics can be used to bridge the gap which can exist between the results of theoretical and experimental approaches to the same problem. It can also be used for computer simulation of plasma experiments and phenomena. Examples of computer simulation are given using a fluid model (MHD) and particle simulation. One-, two-, and three-dimensional calculations are considered. Plasma phenomena at a microscopic level are described by an appropriate kinetic equation and detailed discussion of the methods of solving these equations is given. (UK)

277 PLASMA THEORY. Dougherty, J. P. (Cambridge Univ., Eng.). pp 21-54 of Plasma Physics. Keen, B. E. (ed.). London; Inst. of Physics (1974).

Three ways of picturing plasma dynamics, each forming the basis of a theoretical development, are discussed. These are: (1) Orbits of individual particles, as in elementary dynamics. (2) Fluid dynamics, with additional the feature of electrical conductivity and E and B fields (magnetohydrodynamics). This involves an eulerian description in physical space. (3) Kinetic theory, in which the motion of particles through phase space are pictured, and an eulerian description is set up. This can be traced back to Boltzmann in connection with neutral gases. The Vlasov equation is used for plasmas. (UK)

278 A NEW PROPAGATOR FOR PLASMA TURBULENCE. Misguich, J. H. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee); Balescu, R. (Brussels Univ. (Belgium). Faculte des Sciences). Phys. Lett., A; 48: No. 6, 426-428(29 Jul 1974).

The average propagator of the turbulent Vlasov equation is deduced in the weak coupling approximation, using exact commutation relations for exponential propagators. Many new effects appear, which were not obtained previously by the traditional method based on trajectory calculations. (auth)

279 STATISTICAL DERIVATION OF THE MASS-ACTION LAW FOR INTERACTING GASES AND PLASMAS. Ebeling, W. (Rostock Univ. (German Democratic Republic). Sektion Physik). Physica; 73: No. 3, 573-584(1974).

The derivation of a mass-action law is discussed which takes into account not only the discrete part of the energy spectrum but also the interactions corresponding to the continuous spectrum (e.g., free-free and free-bound interaction). It is shown that a key for the statistical theory of systems with bound states is the principle that bound states must be treated on the same footing as composite particles. As an example a treatment of bound pairs by binary density matrices is developed. The second method is an extension of Lawson's and Dahler's fugacity expansion; after an exact formal rearrangement the mass-action law for the formation of bound pairs, triples, etc., is derived. As an application the ionization phenomena in plasmas and the corresponding Saha equation are discussed. (auth)

280 TIME-DEPENDENT PLASMA MICROFIELD DISTRIBUTION. Rozman, L. J. (National Bureau of Standards, Washington, D. C. (USA)); Hooper, C. F. Jr. (Florida Univ., Gainesville (USA)). Physica; 73: No. 2, 259-286(1974).

The theory of the distribution of the finite-interval time average of the time-dependent low-frequency microfield (ion produced) in a plasma containing ion-ion correlations is developed. The plasma model contains ion-ion interactions in the appropriate statistical ensemble (statistical ion correlations), but does not contain ion interactions in its dynamics (free-streaming dynamics). The theory allows inclusion of statistical ion correlations to any order. A discussion of all approximations is included. (auth)

Production

Refer also to abstract 219.

281 (AD-773439) NONEQUILIBRIUM EFFECTS IN FAST MOVING PLASMAS. Annual Summary Report, March 1972—June 1973. Cooper, A. W.; Schwirzke, F. (Naval Postgraduate School, Monterey, Calif. (USA)). Jul 1973. 23p. (NPS-61SW/CR73121A). NTIS $3.00.

The dependence of the self-generated magnetic fields associated with a laser-produced plasma on position, time, and background pressure was investigated. The presence of the ambient background is found to influence the generation of the fields during the laser irradiation of the plasma. This influence continues long after laser shut-off and causes the fields to reverse their direction. (auth)

282 (AD-777723) COHERENT PRODUCTION OF ENERGETIC ELECTRONS IN ANOMALOUS REFLECTION AND ABSORPTION OF INTENSE LASER LIGHT. Manheimer, W. M.; Klein, H. H. (Naval Research Lab., Washington, D. C. (USA)). Mar 1974. 24p. (NRL-MR-2758). NTIS $3.00.

The rate at which electrons are transported from the body to the nonthermal tail of the distribution function in the nonlinear stage of reflective and absorptive parametric instabilities is computed. The calculation is done by conserving energy and momentum between waves and particles in the nonlinear regime. For the case of reflection, the reflection coefficient and energy flux of nonthermal particles are computed. For absorption, the rate of production of energetic particles is found. Also, the transport of energetic particles into the core of a laser fusion plasma is examined. (auth)

283 (AD-777877) INVESTIGATION OF SELF-GENERATED MAGNETIC FIELDS AND ELECTRON EMISSION IN LASER PRODUCED PLASMAS. Case, R. S. Jr. (Naval Postgraduate School, Monterey, Calif. (USA)). Mar 1974. 138p. NTIS $10.00.

Thesis.

An experimental study of magnetic signals from laser-produced plasmas was performed. From 2 to 30 joules of laser energy impinged upon metallic and hydrocarbon targets in pulse lengths of from 4 to 80 nanoseconds, and at incident angles of 0 and 45 degrees. Two magnetic signals were detected using inductive probes; one whose peak intensity is temporally coincident with, and whose rise time is a function of the incident laser pulse length; the second longer-lasting and time-delayed from the arrival of the laser pulse on target. (auth)

284 (AD-777986) MACROSCOPIC DESCRIPTION OF RADIATION PRESSURE FORCES IN LASER-PRODUCED PLASMAS. Stamper, J. A. (Naval Research Lab., Washington, D. C. (USA)). Apr 1974. 15p. (NRL-MR-2775). NTIS $3.00.

Radiation pressure forces play an important role both in macroscopic and microscopic processes in laser-produced plasmas. A complete description of the macroscopic processes includes radiation driven electric fields as well as radiation driven forces on the neutral plasma. It is shown that a simple expression for the force which has been applied to certain microscopic processes (e.g., parametric instabilities) ignores field momentum and does not give a general description of macroscopic processes. A theory is discussed which does give a general macroscopic description (absorption, reflection, refraction, and magnetic field generation) and which reduces to the above expression, as expected, for sinusoidal fields in a neutral, homogeneous, non-absorbing plasma. (auth)

285 (CEA-R-4491) PLASMA FLOW CREATED FROM LASER IMPACT INTO SOLID TARGETS. Tonon, G. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Sep 1974. 202p. (In French). Dep. NTIS (US Sales Only) $13.25.

Thesis. Submitted to Lyon Univ.

The plasma flow created by a laser beam (the scale of light intensity varied from 10^{12} to 10^{13} W/m^2) on various targets was studied with different diagnostics. The experimental results (electron temperature which can reach 10^{6}°K, electron flow of 10^{22} e m^{-2} s^{-1}, ionic charge C^{6+}, Al^{13+}, Fe^{24+} ...) were confirmed theoretically with a model which takes into account ionization processes and plasma losses. Finally the plasma expansion has also been studied and it has allowed the determination of the ion emission characteristics from the laser intensity. (auth)

286 (SAND-74-0103) LOW ENERGY X-RAY MICRORADIOGRAPHY OF LASER FUSION TARGETS. Prevender, T. S.; Lynch, A. W. (Sandia Labs., Albuquerque, N. Mex. (USA)). Sep 1974. Contract AT(29-1)-789. 13p. Dep. NTIS $4.00.

A low energy x-ray radiography apparatus was developed primarily for the nondestructive inspection of LiD laser fusion targets. Exposure times of 15 minutes at 6 keV have been found satisfactory for the detection of voids in nominal 100 micron diameter spheres. (auth)

287 PULSE UNFOCUSING WITHIN LASER-FUSION REACTORS. Henderson, D. B. (Los Alamos Scientific Lab., N. Mex. (USA)). Nucl. Eng. Des.; 30: No. 1, 111-116(Jul 1974).

Most serious laser-fusion reactor studies involve an atmosphere of lithium vapor within the pulse cavity. The laser pulse ionizes the vapor, generating an "unfocusing" refractive medium. Proper account of this effect may necessitate a lower vapor density than previously reported. (auth)

288 REFLECTION FROM A CO_2 LASER PRODUCED PLASMA. Dyer, P. E.; James, D. J.; Ramsden, S. A.; Skipper, M. A. (Hull Univ. (UK). Dept. of Applied Physics). Phys. Lett., A; 48: No. 4, 311-312(1 Jul 1974).

The efficient absorption of radiation in laser-produced plasma from solid targets is of crucial importance for proposed laser fusion schemes. In this paper preliminary measurements are reported of the reflection coefficient of a carbon plasma produced by a TEA CO_2 laser and the results discussed in terms of a simple model for absorption based on inverse bremsstrahlung. (auth)

289 TIME-RESOLVED LASER-PLASMA BACKSCATTER STUDIES. Ripin, B.H.; McMahon, J.M.; McLean, E.A.; Manheimer, W.M.; Stamper, J.A. (Naval Research Laboratory, Washington, D.C. 20375). Phys. Rev. Lett. 33: No. 11, 634-637 (9 Sept 1974).

Time-resolved and time-integrated measurements of the energy, spectra, and other characteristics of the backscattered laser radiation from a laser-produced plasma are presented. Theoretical comparison shows that most of these measurements are consistent with the stimulated-Brillouin-backscattering instability. (auth)

290 USE OF CO_2 LASER FOR PRODUCING A MULTICHARGED ION SOURCE. Bajard, M.; Perez, A. (Centre d'Etudes de Limeil, Villeneuve-Saint-Georges, France). J. Phys. (Paris), Colloq.; No. 2, 23-28(1973). (In French).

From centenary congress of the French Physical Society; Vittel, France (28 May 1973).

In laser-matter experiments, the characteristics of ion emission are well-known for the case of single laser pulse. These characteristics show different possibilities to produce beams in view of their acceleration either at slow repetition (synchrotron) or at fast repetition (linear, cyclotron). If the beam must be spread in time, the solution could be a deceleration, a natural shift or a confinement; if it must be shortened, a flight extraction will be performed. The working frequency will depend essentially on the laser. The development of high-power molecular lasers, with long wavelength and with high repetition rates, allows one to plan a source based on such a scheme. (FR)

291 LASER-PRODUCED PLASMAS ON SOLID TARGETS. Ciura, A. I.; Mihailescu, I. N.; Popescu, I. M. (Inst. of Atomic

Physics, Bucharest). Stud. Cercet. Fiz.; 26: No. 3, 341-358 (1973). (In Rumanian).

The following topics are briefly discussed: (1) theory of plasma production by lasers and its evolution, (2) mechanisms of laser energy absorption in targets, (3) photoelectric effect, (4) Compton diffusion, (5) pairs generation, (6) inverse bremsstrahlung, (7) inverse synchrotron absorption, (8) anomalous absorption, and (9) confinement of laser-produced plasma. (MOW)

292 LASER COMPRESSION OF MATTER. Roberts, K. V. (Culham Lab., Abingdon, Eng.). pp 311-321 of Plasma Physics. Keen, B. E. (ed.). London; Inst. of Physics (1974).

It is well known that thermonuclear energy can be released explosively by devices with an energy yield in the megaton range. Laser fusion is a proposed method for inducing efficient thermonuclear explosions on a much smaller scale, even down to 1 kilojoule or so, and without the use of a fission trigger. The elementary physical principles on which the method relies are outlined. The development of efficient high-power lasers, the energy absorption and transport, the production of an accurately spherical implosion, diagnostic measurements to check computer calculations and the economics of a possible system, are discussed. Examples of "experiments" which can be carried out on the computer that would be virtually impossible in practice and which can be used to explore the compression processes are discussed. Areas where experiments or further calculations are needed are given. (UK)

Stability

Refer also to abstracts 191, 202, 235, 262, and 330.

293 (AD-777677) EFFECT OF TRAPPING ON THE SATURATION OF THE RAMAN BACKSCATTER INSTABILITY. Klein, H. H.; Ott, E.; Manheimer, W. (Naval Research Lab., Washington, D. C. (USA)). Mar 1974. 11p. (NRL-MR-2757). NTIS $3.00.

The criterion for whether the Raman backscatter instability saturates by electron trapping or by pump depletion was determined and tested by computer simulation. (auth)

294 (FRNC-TH-502) EXPERIMENTAL DISPERSION EQUATION OF LOW FREQUENCY INSTABILITIES FOR CORRELATION MEASUREMENTS. Durel, D. (Paris-11 Univ., 91-Orsay (France)). 1973. 96p. (In French). Dep. NTIS (US Sales Only) $8.00.

Thesis.

A method for calculating the dispersion relation for low frequency instabilities was developed. The well known physical characteristics of ion waves were used to check the validity of this original calculation method. The change in damping and phase velocity was plotted as a function of the frequency for ion waves propagating first in a collisional plasma, and then in a rare gas discharge. A bibliography was developed on the methods used for calculating the dispersion relation for instabilities. The work also includes the development of a simple measurement system. The calculation is based on the determination of the spectral density of the correlation functions. An advantage of this method is that it eliminates the random noise specific to the signal studied. The computer digitizes the signal and the spectral density is calculated using the rapid Fourier transform method. (FR)

295 (LRP-83/74) NEW FINITE ELEMENT APPROACH TO THE NORMAL MODE ANALYSIS IN MAGNETOHYDRODYNAMICS. Appert, K.; Berger, D.; Gruber, R.; Rappaz, J. (Ecole Polytechnique Federale, Lausanne (Switzerland)). Jun 1974. 27p. Dep. NTIS (US Sales Only) $4.50.

The eigenvalue problem arising in the one-dimensional normal mode analysis of fixed boundary magnetohydrodynamic stability is solved by a finite element method. Piecewise constant, discontinuous basis functions are used for two components of the displacement vector because this permits an accurate representation of the nearly divergence-free property of the modes being treated. In spite of the simple basis functions, the accuracy is greatly improved compared to that obtained with piecewise linear, continuous basis functions. Important features of the spectrum, such as infinitely degenerated eigenvalues, accumulation points and continua are well represented by the method. The method used should equally well be applicable to the free boundary stability problem. (auth)

296 (LRP-86/74) FORMATION OF THE HELICOIDAL INSTABILITY OF A SCREW-PINCH MEASURE BY MEANS OF DIPOLAR MAGNETIC PROBES. Pochelon, A.; Keller, R. (Ecole Polytechnique Federale, Lausanne (Switzerland)). Jul 1974. 44p. Dep. NTIS (US Sales Only) $5.25.

The deformation of a screw-pinch plasma column was investigated with pairs of magnetic dipole coils placed along the axis. The influence of on-axis electrodes on the longitudinal current, which gives well-known boundary conditions, is studied in a normal mode development. Measurements of displacement and helical torsion are consistent with the optical data obtained from streak camera photographs. The role of the model used in the interpretation of the results is shown clearly. (auth)

297 (UCID-15814) FURTHER CONSIDERATIONS OF INSTABILITY-THRESHOLD DENSITIES AND INSTABILITY-LIMITED DENSITIES IN BASEBALL I. Foote, J. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Mar 1971. 17p. Dep. NTIS $4.00.

This report contains discussions leading to the following two conclusions: (1) The Baseball I data presented at Novosibirsk, which give an apparent $>B^4$ dependence of the density for onset of observed anomalous ion losses, are not in disagreement after all with the n_i/B^2 variation usually suggested. This conclusion is based on an improved understanding of the parametric variation of the instability threshold. (2) Under certain circumstances, one can expect up to a B^{10} variation in the instability-threshold density for the type of data presented at Novosibirsk. To obtain this result, one takes into account the dependence of the threshold density on the plasma potential. One also assumes an equilibrium ion density that varies as $n_{i,equil} = If\tau_{cx}/V$, i.e., only one type of trapping process, Lorentz trapping, and one type of loss process, charge exchange on the neutral background gas. The justification for these conclusions are given. (MOW)

298 NONLINEAR THEORY OF THERMONUCLEAR ALFVEN PLASMA INSTABILITY. Belikov, V. A.; Kolesnichenko, Ya. I.; Oraevskii, V. N. (Inst. of Nuclear Research, Kiev). Zh. Eksp. Teor. Fiz.; 66: No. 5, 1686-1692(May 1974). (In Russian).

The nonlinear stage of thermonuclear Alfven plasma instability is considered. This instability is excited by high energy ions (α-particles) produced in the thermonuclear reactions. It is demonstrated that due to instability a directed movement of deuterium and tritium ions occurs toward the center of the plasma column and that near the plasma boundary a radial electric field arises. (auth)

299 SELF-ACTION OF AN ELECTROMAGNETIC WAVE IN A PLASMA ON EXCITATION OF PARAMETRIC INSTABILITY. Vas'kov, V. V.; Gurevich, A. V. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 66: No. 5, 1673-1685(May 1974). (In Russian).

Stationary perturbation of the dielectric susceptibility of a plasma in a varying field on excitation of aperiodic instability was found. The structure of the electromagnetic wave field was investigated in the reflection region with allowance for excitation of both periodic and aperiodic parametric instability. The wave reflection coefficient was determined. (auth)

300 STABILIZATION OF SHOCK INSTABILITY AT THE EXPENSE OF INHOMOGENEITY OF THE MEDIUM. Davydova, T. A.; Oraevskii, V. N. (Inst. of Nuclear Research, Kiev). Zh. Eksp. Teor. Fiz.; 66: No. 5, 1613-1621(May 1974). (In Russian).

Nonlinear wave interactions involving positive and negative energy waves in a nonequilibrium inhomogeneous plasma are considered. It is shown that under certain conditions the spatial development of shock instability in an inhomogeneous plasma becomes stabilized. The physical cause of the stabilization is escape of perturbations from the region in which instability development is possible. (auth)

301 THE LIMITATION OF AN EXPLOSIVE INSTABILITY OF TWO COUNTER-STREAMING ELECTRON BEAMS. Sedlacek, Z. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Phys. Lett., A; 48: No. 4, 287-288(1 Jul 1974).

Second-order perturbation calculation shows that an explosive instability of three resonantly interacting waves is limited and converted into a multi-periodic process by nonlinear terms of the same order as those that destabilize the waves in the first-order approximation. (auth)

302 LOW-FREQUENCY INSTABILITIES AND PLASMA TURBULENCE. Ilic, D. B. Stanford, CA; Stanford Univ. (1973). 140p. University Microfilms Order No. 74-6489.

Thesis (Ph. D.).

This work is a theoretical and experimental study of steady-state and time-dependent characteristics of the positive column and the hollow cathode discharge (HCD). It forms part of a wider program on plasma turbulence. The excitation characteristics of the current-driven ion acoustic instability are studied by a linearized kinetic model for a weakly ionized plasma, which predicts convective instability for typical positive column conditions. Results of measurements of steady-state characteristics

of our HCD apparatus are presented, and the influence of discharge conditions on the excitation and suppression of self-excited, low-frequency instabilities is studied. The spatial variations of amplitude and phase of density and potential fluctuations of two such modes are presented, and it is concluded that the ambipolar radial electric has a major role in driving these instabilities. A linear perturbation analysis is given for a model based on a fluid description of a collisionless, cylindrical plasma column in the presence of a static axial magnetic field and with radially-varying number density and radial electric field. The instabilities are identified as centrifugal flute modes, driven by Hall drift in the presence of a density gradient and non-uniform radial electric field. The identification is based on reasonable agreement between theory and experiment of the observed and calculated frequencies, mode numbers, and the spatial variations of eigenfunctions of the density and potential fluctuations. (Diss. Abstr. Int., B)

303 TRAPPED-ELECTRON MODE IN CYLINDRICAL GEOMETRY. Primmerman, C.A.; Lidsky, L.M.; Politzer, P.A. (Department of Nuclear Engineering and Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. Lett. 33: No. 16, 957-960 (14 Oct 1974).

The theory of the cylindrical-geometry analog to the toroidal trapped-electron-scattering mode has been developed, and the resulting equations have been solved numerically. Observations of oscillations occurring near the electron bounce frequency have been made in a plasma confined by a spatially periodic magnetic field. These oscillations were found to be low-amplitude, high-mode-number, drift-type modes having properties consistent with theoretical predictions. (auth)

304 DEVELOPMENT OF "CAVITONS" AND TRAPPING OF rf FIELD. Kim, H.C.; Stenzel, R.L.; Wong, A.Y. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. Lett. 33: No. 15, 886-889 (7 Oct 1974).

A new kind of parametric instability is observed in a nonuniform plasma in which a resonant rf electric field and a density cavity grow simultaneously through mutual enhancements. The threshold is observed to be virtually zero and the growth rate is linearly dependent on pump intensity, E_0^2. Ponderomotive force and wave trapping are observed to be the mechanisms which drive the instability. (auth)

305 RAYLEIGH-TAYLOR INSTABILITY AND LASER-PELLET FUSION. Bodner, S.E. (Lawrence Livermore Laboratory, Livermore, California 94550). Phys. Rev. Lett. 33: No. 13, 761-764 (23 Sept 1974).

The Rayleigh-Taylor instability in laser-driven spherical implosions can be stablized by convective flow and by the "fire-polishing" effect, but the size of the stabilization effect depends on details of the thermal conductivity near the ablation surface. (auth)

306 ION-ION BEAM INSTABILITY IN A CYLINDRICAL GEOMETRY. Hershkowitz, N.; Romesser, T.; Knorr, G.; Goertz, C.K. (Department of Physics and Astronomy, The University of Iowa, Iowa City, Iowa 52242). Phys. Rev. Lett. 33: No. 13, 754-757 (23 Sept 1974).

The ion-ion instability is studied in a cylindrical double-plasma device. Low frequency cylindrical standing waves are found which are one-dimensional in character with frequency proportional to beam velocity. An approximate dispersion relation for the cylindrical standing waves is derived. (auth)

307 STABILITY OF FILAMENTARY STRUCTURES. Valeo, E. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Fluids 17: No. 7, 1391-1393 (July 1974).

Isolated, one-dimensional channels of electromagnetic radiation in a plasma are shown to be unstable to bending perturbations. Let l be the wave vector of the perturbation along the channel, k be that of the radiation, and C_s be the sound speed. Then, the growth rate $\gamma \sim lC_s$ for $l/k \ll 1$. (auth)

308 STABILITY TEST FOR STRONGLY INHOMOGENEOUS PLASMAS THROUGH NYQUIST DIAGRAMS. Bloomberg, H.W. (Department of Physics, College of William and Mary, Williamsburg, Virginia 23185). Phys. Fluids 17: No. 7, 1404-1409 (July 1974).

The stability of inhomogeneous plasma equilibria in the water bag approximation is discussed by means of Nyquist diagrams. A function suitable for a Nyquist diagram is constructed, and the method is applied to demonstrate the instability of the electron sheath configuration. The behavior of the Nyquist diagram shows directly that instabilities occur near multiples of the bounce frequency of the innermost sheath contour in phase space. (auth)

309 PARAMETRIC INSTABILITIES INDUCED BY THE COUPLING OF HIGH AND LOW FREQUENCY PLASMA MODES. Manheimer, W.M.; Ott, E. (Naval Research Laboratory, Washington, D.C. 20375). Phys. Fluids 17: No. 7, 1413-1421 (July 1974).

A general dispersion relation is derived for parametric instabilities caused by a large amplitude pump wave which couples high and low frequency modes of a magnetized plasma. The nonlinear effects coupling the high and low frequency waves are: (1) the low-frequency pondermotive force due to the coupling of the pump with the high frequency perturbations, and (2) the high frequency nonlinear source current density produced by coupling of the pump with the low frequency perturbations. The dispersion relation contains decay instabilities, purely growing instabilities, modulational instabilities, self-focusing and nonlinear Landau damping. As examples the dispersion relation is applied to self-focusing, magnetosonic decay and purely growing instabilities, whistler decay and nonlinear Landau damping of electron plasma waves and transverse electromagnetic waves. (auth)

310 THEORY OF PARAMETRIC INSTABILITY NEAR THE LOWER-HYBRID FREQUENCY. Porkolab, M. (Plasma Physics Laboratory, Princton University, Princeton, New Jersey 08540). Phys. Fluids 17: No. 7, 1432-1442 (July 1974).

The dispersion relation for parametric instabilities near the lower-hybrid frequency is derived and analyzed. It is found that for propagation angles $\cos^2\theta\ (m_i/m_e) \lesssim 1$ resonant decay into ion acoustic (ion-cyclotron) waves does not occur; rather, decay into nonresonant quasi-ion modes and lower-hybrid waves occurs. The driving mechanism for this instability is shown to be analogous to nonlinear Landau damping in perturbation theory. The large amplitude dispersion relation is analyzed numerically for a number of typical experimental regimes, and growth rates and thresholds are obtained for both the purely growing mode and the newly found quasi-ion modes. (auth)

311 EXPERIMENTAL OBSERVATIONS OF THE PARAMETRIC DECAY INSTABILITY. Yadlowsky, E.J.; Goldan, P.D. (Aeronomy Laboratory, National Oceanic and Atmospheric Administration, Boulder, Colorado 80302). Phys. Fluids 17: No. 7, 1443-1448 (July 1974).

The parametric decay instability has been excited in a low-ρ pressure argon plasma characterized by $n_e \sim 5\times10^8$ cm^{-3}, $T_e \sim 2$ eV, $T_i \sim 0.2$ eV. An electron beam probe has been used to measure the frequency and spatial distribution of the fields associated with the pump wave and excited Langmuir and ion waves. The wavenumber matching ($K_0 = K_e + K_i$) and freqwency matching ($\omega_0 = \omega_e + \omega_i$) conditions are well satisfied. If particle losses in the finite geometry are taken into account, the minimum threshold pump electric field is in good quantative agreement with the theoretical prediction $\epsilon_0 E^2/nkT = 64\sqrt{3}/9 \times \gamma_i\gamma^2/\omega^2\omega_r$ in the limit of $\gamma_e > \omega_i \gg \gamma_i$. (auth)

312 SPECTRA AND GROWTH RATES OF A GENERALIZED SCREW PINCH. Vahala, G. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012). Phys. Fluids 17: No. 7, 1449-1460 (July 1974).

The theory of Weitzner for the bumpy θ pinch is extended to the case of a generalized screw pinch in which the equilibrium magnetic field is $B = (\epsilon B_r, \epsilon B_\theta, B_z)$. ϵ represents the slow periodic z variation of the axisymmetric equilibrium and the stability relative to their r variation. Perturbation expansions in ϵ and in the bumpiness of the flux surfaces are performed on the linearized equations of ideal magnetohydrodynamics. From the theory of Grad there should be four stable continua, two of which are found for modes with $\omega^2 = O(\epsilon^2)$, while for the transverse modes a generalized Suydam criterion for local instability is derived. The (global) growth rates of the most unstable transverse modes are computed numerically for various B_θ and the results are compared to those of the bumpy θ pinch (where $B_\theta \equiv 0$) as well as to the ordinary screw pinch (where $B_r \equiv 0$). (auth)

313 EFFECT OF TOROIDAL GRADIENT DRIFTS ON THE DISSIPATIVE TRAPPED-ION INSTABILITY. Tang, W.M. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 17: No. 6, 1249-1257 (June 1974).

Conditions for the onset of the dissipative trapped-ion instability in tokamaks with elliptic and circular cross sections are determined. Toroidal gradient drifts, ignored in earlier calculations, are included in the analysis and found to give rise to significant stabilizing effects. In particular, the results show that the ions trapped in regions of good gradient ($dB/d\rho > 0$) contribute to the Landau damping of the unstable waves, and that ion collisional damping is also enhanced when the drifts are taken into account. Since vertical ellipticity increases the region of good gradient, these stabilizing effects are further enhanced in elliptical cross-section tokamaks. It is also shown that previously calculated restrictions on the allowable magnitude of temperature gradients for favorable damping can be relaxed. Results of the analysis are applied to expected parameters for the Princeton Large Torus experiment and growth rate estimates given for conditions violating the stability criteria. (auth)

314 PARAMETRIC INSTABILITIES IN A PLASMA-BEAM SYSTEM. Khan, T.P. (Dinabandhu Andrews College, Garia- 743505, West Bengal, India). Phys. Fluids 17: No. 6, 1284-1286 (June 1974).

The excitation of electromagnetic transverse waves, cyclotron waves,

and Čerenkov waves by a beam of charged particles moving through a plasma immersed in a crossed electric and magnetic field with a constant uniform velocity parallel to the direction of the external magnetic field has been considered. (auth)

315 EFFECT OF MAGNETIC LINE FANNING ON MICROINSTABILITIES IN MINIMUM-B WELLS. Baldwin, D.E. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Fluids 17: No. 6, 1346-1347 (June 1974).

The fanning of magnetic lines in a minimum-B mirror machine creates distortion of the constant phase surfaces of ion-cyclotron loss cone modes. This distortion can stabilize infinite-medium modes which occur for narrow bands of $k_\perp$. (auth)

316 AXIALLY SYMMETRIC MAGNETOHYDRODYNAMIC EQUILIBRIA WITH FREE-BOUNDARIES AND ARBITRARY CROSS SECTION. Chu, M.S.; Dobrott, D.; Jensen, T.H.; Tamano, T. (General Atomic Company, San Diego, California 92138). Phys. Fluids 17: No. 6, 1183-1187 (June 1974).

An iterative method is used to solve the magnetohydrodynamic equations of free-boundary, axially symmetric equilibria with arbitrary cross section. The method is applied numerically to the study of the plasma equilibrium. The limiter creates a vacuum region outside the plasma. It is shown that the current density profile has a strong effect on the equilibrium. Topologically different equilibria may be obtained by changes in the parameters which determine the current profile. The method is also applied to generate elliptic, D-shape, doublet, and other shapes of equilibria maintained by coil systems. (auth)

317 FIELD-GENERATING THERMAL INSTABILITY IN LASER-HEATED PLASMAS. Tidman, D.A. (Science Applications, Inc., Arlington, Virginia 22209); Shanny, R.A. Phys. Fluids 17: No. 6, 1207-1210 (June 1974).

The intense thermal energy flux emanating from the critical layer in laser-produced plasmas is shown to generate an instability that derives from the magnetic field dependence of the thermal conductivity. This implies that B fields, with their attendant nonuniform heating effects, will occur even in uniformly irradiated spherical pellets or plane slabs. These fields may play a role in attempts to compress pellets for fusion, for example, by being partially trapped and amplified by compression in the interior of a pellet. (auth)

318 SIMULATION OF THE TWO-STREAM CONVECTIVE INSTABILITY. Busnardo-Neto, J.; Rowe, J.E. (Electron Physics Laboratory, Department of Electrical and Computer Engineering, The University of Michigan, Ann Arbor, Michigan 48104). Phys. Fluids 17: No. 6, 1109-1118 (June 1974).

A ring/disk model is used in numerical experiments to investigate the two-stream convective instability in a cylindrically symmetric system with finite transverse dimensions. The spatial growth rates obtained in the linear region agree well with the predictions of the linear theory. The development of a vortex structure in velocity-phase space is associated with the saturation of the instability. Generation and amplification of harmonics occur abundantly as expected. The two electron streams exchange kinetic energy over a very short distance and become thoroughly mixed and randomized (thermalized). Due to the choice of geometry, no coherent oscillations are established in the transverse plane, and although they increase, the radial and angular kinetic energies remain much less than the axial. (auth)

319 DISSIPATIVE TRAPPED-ELECTRON INSTABILITY IN CYLINDRICAL GEOMETRY. Prager, S.C.; Sen, A.K.; Marshall, T.C. (Plasma Research Laboratory, Columbia University, New York, New York 10027). Phys. Rev. Lett. 33: No. 12, 692-695 (16 Sept 1974).

We show that the essential ingredients of the trapped-electron instability can be present in a cylindrical geometry. A linear instability theory, a simple physical explanation, and the results of an experiment are presented to support this. (auth)

320 NONLINEAR THEORY OF IONIZATION INSTABILITY IN A LOW-TEMPERATURE PLASMA. Sinkevich, O. A. (Moscow Energetics Inst.). Sov. Phys.-Dokl. (Engl. Transl.); 18: No. 11, 721-722(May 1974).

Translated from Dokl. Akad. Nauk SSSR; 213: No. 2, 315-317 (Nov 1973).

A nonequilibrium ($T_e \gg T$), partially ionized plasma in an external magnetic field $B(0, 0, B_0)$, which may contain an additional, slightly ionized component is considered. The system of equations describing the state of such a medium is of the form curl $E = 0$, div $J = 0$, $j + j \times \Omega = \sigma E$, $I(\partial n/\partial t + u_m \cdot \nabla n) = \nabla\lambda\nabla T_e + j^2/\sigma - \delta k n T_e/\tau$. An ionization instability develops in the plasma for $\Omega = (e/m_e)B_0\tau > \Omega_c$. At the same time a spatial layer can be formed with a different electron concentration. These layers extend along the magnetic field and are oriented at some angle to the mean plasma current. (MOW)

321 PLASMA STABILITY THEORY. Wesson, J. A. (Culham Lab., Abingdon, Eng.). pp 93-130 of Plasma Physics. Keen, B. E. (ed.). London; Inst. of Physics (1974).

Plasma linear stability theory is considered with respect to the two questions; to which perturbations is a given configuration unstable and what is the growth rate of the instabilities? A number of representative problems are considered which include electrostatic instabilities (two-stream instability including velocity distribution and current flow considerations, the Penrose criterion and the case of maxwellian distributions), and fluid instabilities (Rayleigh-Taylor instability, Kelvin-Helmholtz instability, stability of a pinched plasma and interchange instability). Special topics in stability theory discussed are; the case of a uniform plasma in a uniform field, the effect of finite ion Larmor radius on the Rayleigh-Taylor instability, finite resistivity instabilities, drift instabilities, dynamic stabilization, and feedback stabilization. A comprehensive bibliography is included. (UK)

322 STABILITY PROPERTIES OF BEAM-PLASMA SYSTEMS IN STRONG ELECTROMAGNETIC WAVES. Tsintsadze, N. L. (AN Gruzinskoj SSR, Tbilisi. Inst. Fiziki); Stenflow, L. (Umeaa Univ. (Sweden). Fysiska Institutionen). Phys. Lett., A; 48: No. 6, 399-400(29 Jul 1974).

It is shown that beam-plasma systems can be stabilized if a strong circularly polarized electromagnetic wave is applied. New unstable modes may, however, also be generated. (auth)

323 LONG WAVELENGTH INSTABILITY OF A GENERAL DIFFUSE LINEAR PINCH SURROUNDED BY A HELICAL VACUUM FIELD. Krueger, J. G. (Ghent Rijksuniversiteit (Belgium). Seminarie voor Wiskundige Natuurkunde). Phys. Lett., A; 48: No. 6, 431-432(29 Jul 1974).

In the framework of MHD, a diffuse linear pinch surrounded by a helical vacuum field, is proved to be unstable for long wavelengths, except in the cases that the vacuum field is parallel or perpendicular to the plasma-vacuum interface. (auth)

324 FLUID-LIKE INSTABILITY OF TRAPPED ELECTRONS IN CONFINED PLASMAS. Coppi, B.; Rewoldt, G. (Massachusetts Inst. of Tech., Cambridge (USA)). Phys. Lett., A; 49: No. 1, 36-38(12 Aug 1974).

An instability, which does not depend on mode-particle resonances, can be driven by the drift of trapped electrons in the unfavorable curvature region of the confining magnetic field for selected values of the relevant mode transverse wavelengths. (auth)

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Refer also to abstracts 50, 1129, and 1327.

325 (AD-772532) FLYING CUSP: A Compact Pulsed Fusion System. Robson, A. E. (Naval Research Lab., Washington, D. C. (USA)). Dec 1973. 27p. (NRL-MR-2692). NTIS $4.50.

A dynamic plasma compression system is proposed in which imploding liner techniques of megagauss field generation are combined with plasma containment in cusp geometry. A one-dimensional, thin-liner model is developed in which plasma losses are included self-consistently. Scaling laws are derived for a fusion feasibility experiment based on this principle. (auth)

326 (ANL-8096, pp 144-152) BASIC STUDIES IN THE DEVELOPMENT OF CONTROLLED FUSION. Apr 1974.

In Chemistry Division annual report, July 1972-June 1973.

Brief discussions are given for the following topics: (1) the path of deuterium and tritium in a fusion reactor and its relation to chemical interactions, (2) flux trapping or chemical pumping at metal surfaces, (3) application of matrix-isolation spectroscopy to quantitative sputtering studies, (4) application of matrix-isolation spectroscopy to chemical-sputtering studies, (5) vibrational spectra of water isolated in deuterium spectra, (6) electrochemical generation and measurement of sulfide ion in molten LiCl-KCl eutectic, (7) calculations on refractory metal hydride molecules, and (8) studies of hydrogen in metals by inelastic neutron scattering. (MOW)

327 (AT-AEC-13136) ENVIRONMENTAL ASSESSMENT FOR FUSION REACTOR UTILIZING BROOKHAVEN MINIMUM ACTIVITY BLANKET. Anderson, R. V. (Atomics International Div., Canoga Park, Calif. (USA)). 20 Sep 1974. 89p. Dep. NTIS $5.45.

The University of Wisconsin designed Tokamak Fusion Reactor, UWMAK-I, has been modified to accept the Brookhaven designed minimum activity blanket. This report includes the design integration analysis, accident analysis, and environmental assessment for the resulting design. The minimum activity blanket is helium cooled, with tritium breeding in a solid lithium alloy. This system provides several advantages over the original lithium cooled

blanket, including decreased tritium inventories and decreased induced radionuclide activity. (auth)

328 (CONF-741017-13) POWER BALANCE IMPLICATIONS IN FUSION REACTORS. Steiner, D. (Oak Ridge National Lab., Tenn. (USA)). 1974. 4p. Dep. NTIS $4.00.

From meeting of the American Nuclear Society; Washington, District of Columbia, USA (27 Oct 1974).

The energy balance and its technological implications for four fusion reactor concepts, i.e., the mirror concept, the theta pinch concept, the tokamak, and the laser-pellet concept are discussed. The energy amplification potential of the plasma and blanket can be cast in terms of a total energy multiplication factor which is defined as the ratio of the total fission-produced energy, to the supplied energy absorbed by the plasma. This total energy multiplication factor is discussed for each system. (MOW)

329 (LA-5656-PR) LASL CONTROLLED THERMONUCLEAR RESEARCH PROGRAM. Progress Report for a 12-month Period Ending December 1973. Katz, M. J. (comp.). (Los Alamos Scientific Lab., N. Mex. (USA)). Jul 1974. Contract W-7405-eng-36. 196p. Dep. NTIS $7.60.

A separate abstract was prepared for each of the eight sections of the report. (MOW)

For abstracts of individual sections see: 195, 196, 226, 262, and 330–333.

330 (LA-5656-PR, pp 5-55) THETA-PINCH PROGRAM. Jul 1974.

In LASL Controlled Thermonuclear Research Program.

Summaries of research work during this period are given for the following: (1) theta-pinch activities, (2) Scyllac 8-meter toroidal sector experiment, (3) feedback stabilization experiments on the 8-m toroidal sector, (4) Scyllac torus, (5) staged theta pinch, (6) Scylla IV-3, (7) Scylla I-B, (8) diagnostics, (9) high-density linear theta pinch studies, and (10) automatic data processing. (MOW)

331 (LA-5656-PR, pp 117-123) CTR ENGINEERING. Jul 1974.

In LASL Controlled Thermonuclear Research Program.

The conversion of a 5-meter toroidal sector and a linear experiment into a single toroidal Scyllac experiment is discussed. The toroidal feedback system and components for the capacitor banks for the theta-pinch scientific feasibility experiment are discussed. Failure predictions for CTR systems are also discussed. (MOW)

332 (LA-5656-PR, pp 125-157) FUSION TECHNOLOGY. Jul 1974.

In LASL Controlled Thermonuclear Research Program.

Activity in the reactor technology area commenced in CY 1972 and has accelerated considerably during the past year. The first major iteration on an engineering design of a Reference Theta-Pinch Reactor (RTPR) has been completed jointly by ANL and LASL. An environmental assessment based on this engineering design is near completion. Computational efforts in neutronics, CTR blanket physics, heat transfer/fluid flow, and materials evaluation have generated a realistic calculational base upon which future, more detailed design efforts and reactor assessments can proceed. Numerical simulation of the thermonuclear burn and gas cooling dynamics has been advanced. Experimental research in both insulator and metal technology has moved ahead. (auth)

333 (LA-5656-PR, pp 159-166) MAGNETIC ENERGY TRANSFER AND STORAGE. Jul 1974.

In LASL Controlled Thermonuclear Research Program.

The aim of the superconducting magnetic energy storage and transfer project is to provide energy in the 300-MJ range for plasma compression in the next generations of θ-pinch experiments and reactors and to develop the low-loss superconducting energy storage technology needed for efficient θ-pinch reactors. Highlights of this year's activities have included the following: (1) Placing into operation a new expanded facility for all METS work in a remodeled 31 × 18.5 m building. (2) Construction and preliminary tests of a 200-kJ energy storage coil. (3) Construction of a 3-Ω, 10-kA superconducting switch. (4) Operation of 20-kJ, 5-Ω, 1-kA switches at 90% of short sample critical currents. (5) Operation of a superconducting 1-kA link or "transmission line" between a storage coil and a switch in separate dewars. (6) Modification of energy transfer circuit concept from parallel to series arrangement of coil and switch and experimental demonstration of the operational advantages of this arrangement. (7) Systems parametric analysis which suggests greater economy for direct coupled systems with transfer capacitors than is attainable in transformer coupled systems and in systems which do not use transfer capacitors. (8) Contractual involvement of three industrial groups in the design and construction of additional 300-kJ energy storage coils to assure the needed long-range technological base. (9) Development of design concepts for low-loss superconductors, methods of loss measurement, and initiation of industrial production with adequate quality control of such conductors. (auth)

334 (ORNL-4982) THERMONUCLEAR DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1973. (Oak Ridge National Lab., Tenn. (USA)). Sep 1974. Contract W-7405-eng-26. 73p. Dep. NTIS $5.45.

A separate abstract was prepared for each of the seven sections. (MOW)

For abstracts of individual sections see: 197, 198, 228, and 335–338.

335 (ORNL-4982, pp 21-24) HIGH-BETA PLASMAS. Dandl, R. A.; Eason, H. O.; England, A. C.; Ikegami, H.; Livesey, R. L.; McGuffin, M. W.; Reynolds, J. W.; Wintenberg, R. E. Sep 1974.

In Thermonuclear Division annual progress report for period ending December 31, 1973.

Summaries of research are given for the following areas: (1) ELMO bumpy torus, (2) polarization of free-free bremsstrahlung from magnetically confined plasma, and (3) high-beta plasma in a canted mirror. (MOW)

336 (ORNL-4982, pp 25-29) ENERGETIC PARTICLE INJECTION. Davis, R. C.; Ezell, J. C.; Hall, R. R.; Jernigan, T. C.; Morgan, O. B.; Stewart, L. D.; Stirling, W. L.; Wright, R. E. Sep 1974.

In Thermonuclear Division annual progress report for period ending December 31, 1973.

The primary effort of the Energetic Particle Injection Group has been fabrication and reliable operation of the ORMAK beam lines. Two neutral-injection heating units were installed on ORMAK. Each unit is capable of delivering up to 100 kW of neutral-injected power. Both cold gas streaming and impurity input due to beam operation are within acceptable limits. Improvements in grid design have significantly improved the beam power efficiency. Plasma studies have led to the development of a plasma source which will be a prototype for an ion source employing a 10-cm-dia extraction grid, an increase of a factor of 2 over the present ORMAK source. (auth)

337 (ORNL-4982, pp 39-44) MAGNETICS AND SUPERCONDUCTIVITY. Berry, C. A.; Derby, R. W.; Fitzpatrick, C. M. Sep 1974.

In Thermonuclear Division annual progress report for period ending December 31, 1973.

The efforts of the Magnetics and Superconductivity Group have been in support of both the present plasma physics programs in the division and the planning of future programs. For the present programs a variety of analytical studies of magnet designs, including thermal performance and field calculations, have been completed. A resistance-optimized 50-kG coil for ORMAK with circular bore and rectangular external shape has been fabricated from machined copper plate and is ready for vacuum potting with epoxy. Proof testing of this coil is planned for the coming year. The coils for the ELMO Bumpy Torus have been completed and placed in service after extensive performance and safety tests showed that operation at 30% above design current would be permissible. Field errors are very low (1.5×10^{-4} times the unperturbed axial field) as required for the experimental program. Investigation of platinum underlayers for gold-coated stainless steel to reduce migration of substrate constituents was completed, and this double-layer technique was used to coat a new liner for ORMAK. Numerous diagnostic components were also coated for ORMAK. A program to systematically investigate refractory metal coating for future plasma physics experiments has been started. The first materials of concern are vanadium and niobium. The 106-kG, 7.5-cm-bore Nb_3Sn superconducting magnet was damaged by internal arcing during quench discharges and has been rewound on a newly designed spool to prevent similar damage in the future. A 150-kG Nb_3Sn magnet has been designed for the Physics Division and materials ordered for construction early next year. The major thrust of the superconductivity program has been toward large coils required for future toroidal confinement devices. Conceptual and feasibility designs are being prepared for the feasibility burning experimental device proposals. (auth)

338 (ORNL-4982, pp 47-57) FUSION REACTOR TECHNOLOGY. Alsmiller, R. G.; Barish, J.; Bartine, D. E. Sep 1974.

In Thermonuclear Division annual progress report for period ending December 31, 1973.

During the past year the fusion reactor technology studies have included the following areas of investigation: (1) magnetohydrodynamic effects in fusion reactor blankets, (2) materials

compatability studies, (3) neutronics, (4) radiation damage studies, (5) surface studies, (6) system studies, and (7) tritium handling and recovery. (auth)

339 (ORNL-TM-4634) ORMAK F/BX: A TOKAMAK FUSION TEST REACTOR. Haubenreich, P. N.; Roberts, M. (eds.). (Oak Ridge National Lab., Tenn. (USA)). Jun 1974. Contract W-7405-eng-26. 397p. Dep. NTIS $23.00.

A conceptual design for the USAEC-DCTR's Tokamak Fusion Test Reactor was developed by a team at Oak Ridge. Design objectives included advances in plasma physics understanding, achievement of energy breakeven in a fusioning D-T plasma, and experience in technologies relevant to an experimental fusion power reactor that could begin operation in the next decade. Studies led to a recommended design using superconducting (NbTi) toroidal field coils. The toroidal field magnet system includes 24 coils, each having an oval bore 3.8 by 5.2 m, on a 3.8-m major radius producing a 4.0-tesla magnetic field at the plasma centerline. The plasma has a 0.95-m minor radius and 1.7-MA current. An iron-core plasma-driving system provides 15 volt-sec capability. The plasma temperature is raised to 4.5 keV and fusions are produced by injection of neutral deuterium beams at 150, 75, and 50 keV into a D-T plasma. Plasma energy breakeven (fusion energy equal to injected energy) is predicted with 4.5 MW of injected power and a 25 to 75% D-T mixture. In this case one-half of the fusions are in the background thermal plasma and one-half are due to beam–plasma interactions. Superconducting TF coils and the large plasma-driving capability permit pulses lasting many energy confinement times. Shielding and tritium handling features are designed for extended operation at several thousand shots per year. The project schedule is keyed to the DCTR superconducting magnet development program and input from other large tokamak experiments. (auth)

340 (SAND-74-0067) LASER-FUSION RESEARCH PROGRESS REPORT, JULY–DECEMBER 1973. Beckner, E. H. (Sandia Labs., Albuquerque, N. Mex. (USA)). Sep 1974. Contract AT(29-1)-789. 45p. Dep. NTIS $4.00.

Construction and checkout of the four-beam laser was completed, and initial experiments were begun on irradiation of small CD_2 pellets. The full array of diagnostic equipment was completed and installed on the target chamber for the four-beam laser experiments. The picosecond laser was utilized in a series of laser plasma experiments to demonstrate its utility for obtaining frequency doubled interference holograms of laser-produced plasma. Research on a longitudinally pumped dye laser is described. Extensive studies of electron-beam-initiated HF lasers, Xe molecular lasers, iodine lasers, and CO_2 lasers are described. (MOW)

341 (UCID-15652) TOROIDAL STABILIZED PINCH FORMED WITH RELATIVISTIC ELECTRONS. Hartman, C. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 May 1970. 30p. Dep. NTIS $4.50.

A plasma confinement and heating configuration is described in which a toroidal stabilized pinch is formed in a plasma of relativistic electrons confined by minimum |B| mirror fields. Electrons which enter the closed-field region of the pinch and remain trapped by the magnetic field produce intense heating of the ions while electrons on passing trajectories accelerated by the pinch induction field become highly relativistic and carry the main pinch current. For energetic electron plasma produced by electron-cyclotron-resonance heating (with presently available microwave sources) pinch current in the megampere range is predicted along with ion heating to multikeV temperature. (auth)

342 (UCID-15731) DESIGN FOR A HIGH POWER DENSITY ASTRON REACTOR. Christofilos, N. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Sep 1970. 25p. Dep. NTIS $4.25.

The following topics are discussed in some detail: (1) simplified high power Astron reactor design, (2) high power density niobiumless blanket, (3) a new task for the E-layer, and (4) overall fusion economy. The major item in the development of an Astron reactor is a proton accelerator. Some of the requirements of the facility are outlined. (MOW)

343 (UCID-15747) LIFE TESTING OF TYPE "A" IGNITRONS. Headley, F. B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Jul 1970. 11p. Dep. NTIS $4.00.

This test was conducted to compare the operating characteristics of size "A" ignitrons having molybdenum anodes as manufactured by three US manufacturers. The test procedure was to operate two representative tubes from each of the manufacturers, under the actual conditions they would experience in the 2XII machine, and determine their lifetime. The actual test procedure and the obtained results are described. (MOW)

344 (UCID-15750) D–He_3 CYCLE: POWER BALANCE, WASTE HEAT, AND NEUTRON POWER. Post, R. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Aug 1970. 9p. Dep. NTIS $4.00.

The results are described for preliminary calculations of power balance, waste heat rejection, and neutron power for D–^{3}He cycles, as a function of confinement quality ($n\tau$) and of the relative concentration of ^{3}He and deuterium in the fusion fuel mixture. Two different fuel mixture regimes are considered: low ^{3}He concentration (20% to 30%) offers the advantage that no external breeding is required, the ^{3}He concentration being provided in steady state by reinjecting ^{3}He produced by the accompanying DD reactions. Higher ^{3}He concentrations would require an external source but would result in lowered neutron power. (auth)

345 (UCID-15770) E-LAYER EQUILIBRIUM IN THE PRESENCE OF TOROIDAL MAGNETIC FIELD. Christofilos, N. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Dec 1970. 10p. Dep. NTIS $4.00.

Calculations are presented of the current distribution of a relativistic electron beam in the presence of an axial magnetic field. It is shown that the relativistic beam and the E-layer are diamagnetic to the applied axial and toroidal fields, respectively. The E-layer current remains substantially normal to the magnetic field. (MOW)

346 (UCID-15878) DEVELOPMENT OF EQUIPMENT FOR HIGH REPETITION RATE OPERATION OF THE ASTRON INJECTOR. Smith, B. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Jun 1971. 9p. Dep. NTIS $4.00.

The following topics are briefly discussed: (1) the Astron injector, (2) hard tube modulators, (3) reset pulser, (4) reset power supply, and (5) operational experience with the fast pulse equipment. (MOW)

347 (UCID-15881) THREE AND ONE-HALF YEARS OF ASTRON PHYSICS, FEBRUARY 1968 THROUGH JULY 1971. Christofilos, N. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 July 1971. 31p. Dep. NTIS $4.75.

Experimental and theoretical work done on Astron during this period is outlined. The first important experiment done with the new Astron tanks was to verify the theory of stabilization of the precessional mode. Another important milestone in the Astron program is the stacking of two pulses injected a millisecond apart. Toroidal field experiments are also discussed. The theoretical program has dealt mainly with precessional oscillations and hybrid-mode instability calculations. (MOW)

348 (UCID-15942) ELECTROSTATIC PRECESSIONS. Condit, W. C. Jr.; Lovelace, R. V. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Aug 1971. 10p. Dep. NTIS $4.00.

A computation is given of the precessional motion of an unneutralized E-layer due to image charges on the walls of the Astron tank. The layer is treated as an infinitely long and rigid cylinder (after Berk and Sudan, UCRL-72754). Its axis is taken as displaced an amount ϵ from the axis of the conducting tank, and the parameted ϵ/ρ_0 is taken as small, where ρ_0 is the E-layer equilibrium radius. Under the assumption of rigid or coherent precessions only the motion of a single typical particle need be computed, and the full relativistic equations for such a particle are solved to first order in ϵ/ρ_0. The results indicate that the electrostatic precessions of the E-layer occur at a much higher frequency than the magnetic precessions which have been observed after the E-layer is neutralized. (auth)

349 (UCID-16029) ELECTROMAGNETIC PUMPING TO ELIMINATE MHD PRESSURE DROPS IN FUSION REACTOR BLANKETS. Carlson, G. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Apr 1972. Contract W-7405-eng-48. 7p. Dep. NTIS $4.00.

An analysis is presented of the conversion of a pipe section in a strong transverse magnetic field into a dc conduction type electromagnetic pump. In the case considered the applied electric potential is just sufficient to eliminate the MHD pressure drop in the pipe. It is shown that the electric power consumed by this pump is always greater than the flow power loss in the pipe alone. (auth)

350 (UCID-16585) DIRECT CONVERTER EFFICIENCY WITH A 100:1 EXPANDER. Barr, W. L.; Howard, B. C.; Moir, R. W. (California Univ., Livermore (USA). Lawrence Lab.). 9 Sep 1974. Contract W-7405-eng-48. 7p. Dep. NTIS $4.00.

A 22-stage direct converter is described for use with a 100:1 magnetic expander. The small expansion ratio results in the rather low efficiency of 63%. (auth)

351 "MEMORANDUM ON THE TECHNOLOGICAL PROBLEMS OF THE FUSION REACTOR" AND THE "FUSION REACTOR TECHNOLOGICAL PROGRAM". Buende, R. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Brennst.-Waerme-Kraft; 26: No. 8, 352-355(Aug 1974). (In German).

The article shows the most important parts of the "Memorandum" and the "Technological Program", and explains the objectives. It describes, in particular, the work required for reaching the final goal i.e. the economically operating fusion reactor-power station, e.g. the physical basis, type of plasma confinement, system studies, safety and materials problems. (auth)

352 NUCLEAR FUSION. How Far is the Research. Klingelhoefer, R. Bild Wiss.; 11: No. 7, 36-42(Jul 1974). (In German). 6 figs.

An easily understandable survey on the principle and technical realization problems of nuclear fusion is given. The most important possibilities investigated up to present of the plasma confinement (tokamak, stellarator, theta-pinch, magnetic mirror machine) are illustrated, occurence and breeding of fusion fuels, wall material and cooling problems, required safety measures as well as the advantages of the fusion reactor are discussed. (auth)

353 PROGRAMME ADJUSTMENTS BY THE EUROPEAN COMMUNITIES IN THE FIELD OF CONTROLLED THERMONUCLEAR FUSION AND PLASMA PHYSICS (EXTENSION OF THE EC-PROGRAMME FUSION). Technol.-Nachr. Sonderd. Progr.; No. 79, 1-8(Dec 1973). (In German).

The extension of the European Communities called for an adjustment of the research projects existing in the new member states so as to make them fit into and correlate them with the existing research programmes of the European Communities. This has been done among others with the program for "Controlled thermonuclear fusion and plasma physics", in order to correlate the work performed in Great Britain and Denmark with the program of the Communities, as of January 1, 1973, by means of association agreements. The adjustment of the work done within the framework of the UKAEA of the years 1973, 1974 and 1975 to the Joint Fife-Year Programme of the Communities up to the year 1975 is explained in this contribution. (auth)

354 PHYSICS AND THE ENERGY PROBLEM, 1974. Proceedings of the American Physical Society Topical Conference on Energy Held in Chicago, Illinois, February 4–7, 1974. Fiske, M. D.; Havens, W. W. Jr. AIP Conference Proceedings, No. 19. New York; American Institute of Physics (1974). 436p. (CONF-740201-).

A separate abstract was prepared for seven of the twenty-seven papers presented at the conference. The remaining twenty papers were not in scope for NSA. (RCK)

For abstracts of individual papers see: 355–358, 1304, 2382, and 2530.

355 LASERS FOR FUSION. Brueckner, K. A. (KMS Fusion, Inc., Ann Arbor, MI). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 19, 260-298(1974).

From tropical conference on energy; Chicago, Illinois, USA (4 Feb 1974). See CONF-740201-.

The extremely high power achievable with lasers offers the possibility of producing fusion in laser heated and inertially confined pellets of thermonuclear fuel. Special techniques of laser pulse forming properly matched to pellet size allow energy multiplication to occur with lasers which are presently technologically feasible. These techniques will be described and the current status of theory and experiments will be given. General engineering features of possible fusion reactors will be summarized. (auth)

356 ELECTRON-BEAM-INDUCED FUSION. Yonas, G. (Sandia Labs., Albuquerque, NM). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 19, 299-313(1974).

From topical conference on energy; Chicago, Illinois, USA (4 Feb 1974). See CONF-740201-.

The use of tightly focused relativistic electron beams has only recently been seriously considered as an alternative to lasers as a means of heating and compressing matter for achieving fusion. The potential attractiveness of this approach stems from the demonstrated high efficiency, intrinsic simplicity, and the ability to scale pulsed power and electron beam technology. In particular, the foundation has already been prepared to allow one to embark on the development of a 10^{13} W pulsed electron accelerator to deliver 10^5 J or more to a spherical target. Although such a device will in the future allow one to test more fully the feasibility of the concept, many of the fundamental questions related to the principles underlying this idea present exciting challenges to the physics community and can be tested with considerably smaller facilities. The important questions include the limitations of electron beam focusing, symmetry of irradiation of mm size pellets, and energy deposition. Vital tools in addressing these questions are (1) the existing $\sim 10^{12}$ W pulsers which are being used to determine the properties of focused beams as well as the response of materials subjected to the high energy densities which can be created, and (2) numerical methods for understanding the behavior of these beams. Results to date include the successful focusing of electron beams to provide power densities of $\sim 10^{13}$ W/cm^2, initial studies of energy absorption, and numerical studies complementing these experiments. Recent progress as well as areas for further study, particularly oriented toward the creation of reactor concepts will be delineated. (auth)

357 MAGNETIC CONFINEMENT OF THERMONUCLEAR PLASMAS. Furth, H. P. (Princeton Univ., NJ). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 19, 314-336(1974).

From topical conference on energy; Chicago, Illinois, USA (4 Feb 1974). See CONF-740201-.

Toroidal reactors will require a ~10-keV DT plasma with $n\tau$ (density times confinement time) exceeding $\sim 10^{14}$ cm^{-3} sec. Present-day toroidal plasmas come within 2 to 3 orders of magnitude in respect to $n\tau$, and within less than an order of magnitude in respect to temperature. Toroidal loss processes appear to be diffusive, so that $n\tau$ increases with size. In the low-pressure ("low-β") approach, typified by the tokamak, the principal physics problems are: (1) to develop scaling laws for plasma diffusion (a problem of nonlinear microscopic instability); (2) to minimize impurity evolution from plasma-wall interactions (a surface physics problem); (3) to find grossly stable configurations maximizing $n\tau$ (a MHD-stability problem). The high-β approach, typified by the toroidal θ-pinch, is related to item (3). Plasma pressure and density are raised to their limits by special MHD-stabilization techniques, including feedback. Development of shock and compressional heating techniques plays an important role. An alternative reactor approach is the open-ended magnetic bottle, or "mirror machine." A non-Maxwellian (beam-injected) ion population in the energy range >100 keV interacts with itself or with a plasma target. The $n\tau$-value depends on velocity-space distribution rather than on size; present-day $n\tau$-values need to be improved by 2 to 3 orders of magnitude. The principal physics problem is anomalous endloss—a problem of nonlinear high-frequency instability, somewhat like laser action. (auth)

358 PHYSICS PROBLEMS OF THERMONUCLEAR REACTORS. Ribe, F. L. (Los Alamos Scientific Lab., NM). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 19, 337-356(1974).

From topical conference on energy; Chicago, Illinois, USA (4 Feb 1974). See CONF-740201-.

A problem common to all controlled fusion reactors is that of the burning deuterium–tritium fuel under conditions of plasma confinement which approach the ideal limit as nearly as possible. After ignition, the balance between alpha-particle energy deposition and plasma losses (radiation plus thermal and particle diffusion) determines the stability or instability of the burn in toroidal systems. Tokamak systems are described both with unstable, injection-regulated burn cycles and stabilized steady-state burn conditions. In the theta-pinch reactor an unstable burn occurs, somewhat regulated by high-beta plasma expansion, which is quenched by a programmed plasma decompression. The plasma expansion during the constant-pressure burn provides "direct" conversion of plasma thermonuclear heat to electrical output, in addition to the electrical power derived from the neutron energy through conventional thermal conversion equipment. The open-ended mirror reactor is characterized by a direct conversion system for recovering end-loss plasma energy and converting it to electrical energy for reinjection into the plasma. This allows a favorable reactor energy balance as an amplification factor Q (= thermonuclear energy output/injected plasma energy) which is compatible with classical collisional losses. For the three reactor types considered the ramifications of burn and confinement conditions for reactor configuration, energy balance, economy, fuel handling, materials problems, and environmental-radiological factors are considered. (auth)

359 ROLE OF FUSION POWER IN RESEARCH AND DEVELOPMENT OF NEW ENERGY SOURCE. Bagatin, M. (Univ., Padua). pp 86-88 of Energy, Europe and the 1980's. London; Institution of Electrical Engineers (1974).

From international conference on the energy, Europe and the 1980's; London, UK (6 May 1974). See CONF-740560-.

It is stated that, since the scientific feasibility of fusion power seems now a visible goal, efforts are extending from the theoretical plane to engineering problems of fusion reactors. The feasibility studies of prototypes can be classified in toroidal,

mirror-type, and laser reactors. These are discussed separately. Economic and environmental considerations are also discussed. (UK)

Wave Phenomena

360 (AD-778472) NONLINEAR BEHAVIOUR OF ION WAVES. Final Scientific Report, 1 January–31 December 1973. Anastassiades, A. J. (Democritus Nuclear Research Center, Athens (Greece)). 15 Feb 1974. Contract F44620-73-C-0039. 13p. (AFOSR-TR-74-0694). NTIS $3.00.

Experimental evidence of the excitation of higher harmonics in the presence of an ion-acoustic wave stability is presented. This instability was excited in an argon plasma column which was produced in a magnetic field of 110 gauss. The pressure of the plasma was between 1 micrometer Hg and 3 micrometer Hg with an ion density of 10^{11}/cc and an electron temperature of 2 eV. The ion acoustic wave is excited by the drifting electrons in the plasma. The drift motion is the result of the dc electric field between the cathode and two grids which are kept at ground potential. The electron drift velocity was estimated to be 4×10^6 cm/sec. The low frequency oscillations were detected by a Langmuir probe and analyzed by a panoramic spectrum analyzer. With cathode potential of 100 V and 160 V, anode currents were 1.0 and 1.6 A respectively. At 200 V the anode current was 1.8 A. (auth)

361 (NP–20203) CHARACTERISTIC EXAMPLES OF WAVE PROPAGATION IN INHOMOGENEOUS PLASMAS. Raeuchle, E. (Stuttgart Univ. (TH) (F. R. Germany)). 12 Dec 1972. 112p. (In German). INIS.

With figs.; 41 refs. With abstract. Available from the library of the Stuttgart Univ.

The following characteristic examples of wave propagation in inhomogeneous plasmas are treated mathematically: 1) Electromagnetic waves in cylindrical cavity resonators. 2) Wave and diffusion instabilities in the inhomogeneous positive column. It is assumed that the plasma is inhomogeneous only in one direction (for cylindrical plasmas e.g., in radial direction). The mathematical description of wave propagation leads to eigenvalue problems in the form of coupled differential equations. For the numerical solution of these equations, a general computer program has been set up, as well as a computer program for complex zero point search based upon residue calculations which permits the determination of the number of zero points and the calculation of the position of a single or double zero point within a given complex area. (auth)

362 MULTIPLE RESONANCE EXCITATION OF A PLASMA COLUMN. Bender, A. D. Pittsburgh; Carnegie-Mellon Univ. (1974). 189p. University Microfilms Order No. 74-20,057.

Thesis (Ph. D.).

The high frequency, $\omega_{ce} \leq \omega \leq 3\,\omega_{ce}$, and low frequency, $\omega_{ci} \leq \omega \leq \omega_{LH}$, resonances of a plasma column were excited singly and simultaneously by means of up to 1 kW of microwaves of 2.45 GHz and up to 1 kW of rf in a frequency in the range of 4 to 25 MHz. A shielded helical slow-wave structure, 4 cm diameter, 22 cm long with pitch 0.6 cm, is used to generate the plasma and to excite the resonances at one end of the system in a region of uniform magnetic field, which forms one end of a semi-symmetric mirror machine with a mirror ratio of 3 and a length of 80 cm. The microwave power is fed coaxially between two adjacent turns of the helix while the rf power is coupled inductively between the ends of the helix. An electromagnetically actuated needle valve releases up to 150 μl of hydrogen gas in one msec into the region of the helix which has been excited with a one sec power pulse. The generated plasma has a duration of 100 msec. Diagnostics include axial and radial asymmetric floating double probes; a retarding potential ion energy analyzer; a fast response neutral density analyzer; electrostatic and electromagnetic field probes. Large coupling of external power to the plasma is observed in the above frequency ranges. Typical measured plasma parameters are: $n_e \sim 10^{11}$ el/cm^3, $T_e \sim 20$ to 70 eV, $T_i \sim 2$ to 40 eV and 1% ionization. When the plasma is excited simultaneously at the high frequency and low frequency resonances, the percent ionization and electron temperature are doubled and the ion temperature initially increases by 20% but in the steady state decreases 50%, due to the simultaneous faster depletion of the neutral hydrogen density thereby depriving the accelerated ions of the principal collisional thermalization mechanism in this experiment. Field measurements have been carried out at the externally applied high frequency (GHz) and low frequency (MHz) resonance excitations as well as at an observed very low frequency (5 to 40 KHz) range. (Diss. Abstr. Int., B)

363 FIELDS OF AN ELECTRIC DIPOLE PERPENDICULAR TO A MAGNETOSTATIC FIELD IN A HOT PLASMA. Singh, N. (Indian Inst. of Tech., Kanpur). IEEE (Inst. Elec. Electron. Eng.), Trans. Antennas; AP-22: No. 3, 505-507(May 1974).

The radiation fields of an electric dipole oriented perpendicular to the magnetostatic field in a hot uniaxial plasma are considered. The behavior of the fields near the resonance cone for the perpendicular and parallel orientations are found to be similar. A procedure is shown for estimating the electron temperature and density by measurements on the characteristic angular distribution of the fields near the resonance cone. (auth)

364 MEASUREMENTS OF THE TRANSMITTING AND THE RECEIVING PATTERNS OF A DIPOLE ANTENNA FOR AN ELECTRON PLASMA WAVE. Ishizone, T.; Sawaya, K.; Adachi, S.; Mushiake, Y. (Tohoku Univ., Sendai). IEEE (Inst. Elec. Electron. Eng.), Trans. Antennas; AP-22: No. 5, 662-666(Sep 1974).

The transmitting and the receiving patterns of a dipole antenna for an electron plasma wave were measured by using the interference method. The results agree fairly well with the theoretical patterns that were predicted from the fluid model analysis and also experimentally prove the reciprocity relationship between the transmitting and the receiving patterns, which is theoretically found to be valid in the plasma wave approximation. The characteristics of the transmitting and the receiving efficiencies versus the dc bias voltage applied to the dipole antenna were also experimentally investigated. (auth)

365 NONLINEAR WAVE IN AN ANISOTROPIC PLASMA. Berezin, Yu. A.; Bshivkov, V. A. (Computer Center, Novosibirsk, USSR). Chislennye Metody Mekh. Sploshnoi Sredy; 2: No. 3, 3-15(1971). (In Russian).

Equations are developed mathematically and the linear and nonlinear solutions are plotted for comparison. The system of equations developed may be used for studying the turbulence spectrum in a coil under some conditions. (auth)

366 NONLINEAR EXCITATION OF LONGITUDINAL WAVES ON THE MAGNETOACTIVE PLASMA BOUNDARY BY ELECTROMAGNETIC WAVES. Benkhabib, F. (Kharkov State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 5, 840-841(May 1974). (In Russian).

Two high-frequency linearly polarized waves impinge on a semi-confined magnetoactive plasma perpendicular to the interface. During nonlinear examination of the problem at the plasma boundary, ion-sonic and Langmuir waves were excited at the difference and sum frequencies. The amplitudes of these waves and the coefficients of nonlinear transformation, which were determined as the ratio of the energy currents of the plasma and incident waves, were calculated. The transformation coefficients show a maximum if one of the frequencies of the incident wave is close to the cyclotron frequency. (tr-auth)

367 CORRELATION MEASUREMENTS OF OSCILLATIONS DEVELOPING IN TRAP WITH MAGNETIC STOPPERS DURING INTERACTION OF SPIRAL BEAM WITH PLASMA. Akshanov, B. S.; Zeidlits, V. P.; Strel'tsov, A. I.; Smirnov, A. M.; Uvarov, V. T. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 5, 853-854(May 1974). (In Russian).

Oscillograms of the stochastic oscillations responsible for the heating of the corresponding plasma components were photographed. By computer processing of these oscillograms, the prompt spectra of the oscillation, the degree of its phase randomness, and the correlation times were found. In the case of heating of the plasma ions the maximum value of the amplitudes of the oscillations was observed at a frequency of 0.3 MHz which corresponds to the frequency of the ion-sonic oscillation. During heating of the plasma electrons the maximum of the amplitudes of the integral spectra was observed at a frequency of 700 MHz, whereas in the prompt spectra this frequency is half as large (350 MHz) and corresponds to the frequency of the whistling atmospherics. (tr-auth)

368 NONLINEAR PENETRATION OF A PLASMA BY AN ELECTROMAGNETIC WAVE AND NONDECAY MECHANISMS OF ITS ENERGY DISSIPATION. Sagdeev, R. Z.; Shapiro, V. D. (Inst. of Cosmic Research, Moscow). Zh. Eksp. Teor. Fiz.; 66: No. 5, 1651-1667(May 1974). (In Russian).

A nonlinear solution was obtained that describes the penetration of an obliquely incident electromagnetic wave into an inhomogeneous plasma in the case of sufficiently large amplitudes when allowance for the wave pressure is important. It is demonstrated that penetration of the wave beyond a critical point $\omega_p(z) = \omega$ is accompanied by its transformation into plasma oscillations; the corresponding transformation coefficient is found. Two nonlinear mechanisms of electromagnetic energy dissipation are investigated for the case of normal incidence; the mechanisms appear in a plasma constrained by the wave pressure and involve excitation of plasma oscillations in the vicinity of the point $\omega_p = 2\omega$ and absorption of the wave energy by particles in the skin layer. (auth)

369 NONLINEAR PLASMA OSCILLATIONS IN TERMS OF VAN KAMPEN MODES. The Initial-Value Problem. Best, R. W. B. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). Physica; 74: No. 1, 183-195(1974).

The Landau-Vlasov initial-value problem is solved to second order in the field amplitude, using a secularity-free expansion method and neglecting no terms except of third and higher order. Apart from the Landau poles near the plasma frequency ω_p, and the poles at the sum and difference frequencies near $2\omega_p$ and 0, also some new poles are found between 0 and ω_p corresponding to second-order waves with the same phase velocity as one of the generating first-order waves, and the difference of their wave numbers. (auth)

370 RELATIVISTIC PLASMA-DYNAMICAL EQUATIONS AND PLASMA-DYNAMICAL NORMAL MODES. Balescu, R.; Brenig, L.; Paiva-Veretennicoff, I. (Brussels Univ. (Belgium). Faculte des Sciences). Physica; 74: No. 3, 447-465(15 Jun 1974).

The equations of evolution of a relativistic plasma and radiation are derived from the macroscopic conservation laws. The delicate concepts of a spatially homogeneous and of a weakly inhomogeneous system are defined in a covariant way. By using standard procedures of nonequilibrium thermodynamics, a closed set of linearized relativistic plasma-dynamical equations coupled to Maxwell's equation is obtained. The plasma-dynamical normal modes are derived from these equations. They are discussed in detail, with special emphasis on the deep differences appearing between these modes and the hydrodynamical modes of a normal fluid. These differences are due both to collective plasma motions and to relativistic effects. (auth)

371 EFFECT OF BEAM DENSITY AND OF HIGHER HARMONICS ON BEAM-PLASMA INTERACTION. Lacina, J.; Krlin, L.; Koerbel, S. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Phys. Lett., A; 48: No. 4, 271-272(1 Jul 1974).

The interaction of a cold beam–plasma system is investigated numerically in the density ratio $\eta = \bar{n}_b/\bar{n}_p = 2 \times 10^{-3} + 2 \times 10^{-2}$ ($\bar{n}_b$ is the beam density, $\bar{n}_p$ is the plasma density). The time development of the wave with maximal growing rate and its higher harmonics is studied. (auth)

372 A KORTEWEG-DE VRIES EQUATION FOR NONLINEAR DRIFT WAVES. Todoroki, J.; Sanuki, H. (Nihon Univ., Tokyo. Dept. of Physics). Phys. Lett., A; 48: No. 4, 277-278 (1 Jul 1974).

A nonlinear drift wave in a low pressure collisionless plasma is considered by a perturbation method. A modified Koretweg-de Vries equation is derived for nonlinear drift waves sustained by temperature and density gradients. (auth)

373 EFFECTS OF ION NEUTRAL COLLISIONS ON ION-WAVES. Cussenot, J. R.; Fabry, M. (Nancy-1 Univ., 54 (France). Lab. de Physique des Milieux Ionises). Phys. Lett., A; 48: No. 4, 291-292(1 Jul 1974).

Ion neutral collisions are taken into consideration in the ion kinetic equation by introducing a relaxation term. Properties of phase velocity and damping versus wave frequency and collisions are studied. (auth)

374 COMPUTATIONAL STUDY OF NONLINEAR PLASMA WAVES. Matsuda, Y. Stanford, CA; Stanford Univ. (1974). 174p. University Microfilms Order No. 74-20,211.

Thesis (Ph. D.).

A low-noise plasma simulation model was developed and applied to a series of linear and nonlinear problems associated with electrostatic wave propagation in a one-dimensional, collisionless, Maxwellian plasma, in the absence of a magnetic field. It is demonstrated that use of the hybrid simulation model allows economical studies to be carried out in both the linear and nonlinear regimes with better quantitative results, for comparable computing time, than can be obtained by conventional particle simulation models, or direct solution of the Vlasov equation. The characteristics of the hybrid simulation model itself are first investigated, and it is shown to be capable of verifying the theoretical linear dispersion relation at wave energy levels as low as 10^{-6} of the plasma thermal energy. Having established the validity of the hybrid simulation model, it is then used to study the nonlinear dynamics of a monochromatic wave, sideband instability due to trapped particles, and satellite growth. The simulations are performed in parameter ranges such that detailed quantitative comparison with available theories is possible. In particular, the transition from time-asymptotic amplitude oscillation to continuous Landau damping is investigated for a monochromatic wave as the initial wave amplitude is varied. The results, which include a small nonlinear frequency shift, compare favorably with theory. The study of sideband instability confirms the applicability of quasi-linear theory at short times, and parametric coupling theory in the time-asymptotic limit, and reproduces features analogous to those observed in laboratory experiments. The growth of a satellite wave in the presence of a large amplitude wave and a test wave is shown to be explicable by a simple theory involving slow modulation of the large amplitude wave. It is concluded that the hybrid simulation model constitutes a reliable and economical tool for use in the study of plasma phenomena. It should be widely applicable to the testing of predictions of linear and nonlinear theories, and the description of more complicated situations which are not amenable to analysis. (Diss. Abstr. Int., B)

375 SPECTRUM OF TURBULENCE AT A MAGNETIC NEUTRAL POINT. Baum, P.J.; Bratenahl, A. (Physics Department and Institute of Geophysics and Planetary Physics, University of California, Riverside, California 92502). Phys. Fluids 17: No. 6, 1232-1235 (June 1974).

The spectral density of plasma waves generated at the x–type magnetic neutral point of a laboratory device known as the double inverse pinch has been measured using a double probe technique devised by Hamberger and Jancarik. The spectra peak at low frequencies and have no components above the ion plasma frequency. This is in general agreement with the ion–acoustic wave spectrum of Kadomtsev. No contribution is seen at frequencies characteristic of the two–stream instability. The plasma wave amplitude is estimated to be sufficient to produce the anomalous resistivity which has been observed in this device. A knowledge of the resistivity mechanism is essential in understanding neutral point phenomenon as the resistivity controls "the reconnection rate" or more precisely the flux transfer rate. Flux transfer is almost certainly a key element of solar flares and geomagnetic substorms. The flux transfer process also occurs in many laboratory plasma experiments. (auth)

376 MICROWAVE SCATTERING FROM AN OVERDENSE TURBULENT PLASMA. Attwood, D. (New York University, Bronx, New York 10453). Phys. Fluids 17: No. 6, 1224-1231 (June 1974).

Experimental results of microwave scattering from a turbulent plasma are presented. For underdense values of mean and fluctuation electron density, scattering is similar to that noted by several other groups, following Born predictions for very weak scattering and saturating as the critical point is approached. Near the critical point for average electron density, a crossover from volume to surface scattering is observed. For sufficiently overdense values, scattering resembles that from a reflecting surface of appropriate shape and statistics, mean density distribution notwithstanding. Scattering in this latter regime is used as a diagnostic tool to determine the probability distribution function for orientation fluctuations displayed by the overdense thrashing plasma column. (auth)

377 STIMULATED SCATTERING OF ELECTROMAGNETIC ORDINARY WAVES FROM ELECTRON PLASMA WAVES AT THE UPPER HYBRID FREQUENCY. Lee, K.F. (Department of Electronics, The Chinese University of Hong Kong, Shatin, N. T., Hong Kong). Phys. Fluids 17: No. 6, 1220-1223 (June 1974).

Stimulated scattering of electromagnetic waves of ordinary polarization incident on a magnetized plasma from electrostatic waves propagating normal to an external magnetic field at the upper hybrid frequency is studied. The analysis is based on a multiple–time–scale perturbation expansion of the fluid equations, incorporating the effects of temperature, collisions, and the spatial variation of the pump wave. The threshold intensity required for the process and the growth rate above threshold are calculated. (auth)

378 RAMAN AND BRILLOUIN SCATTERING OF ELECTROMAGNETIC WAVES IN INHOMOGENEOUS PLASMAS. Liu, C.S.; Rosenbluth, M.N.; White, R.B. (Institute for Advanced Study, Princeton, New Jersey 08540). Phys. Fluids 17: No. 6, 1211-1219 (June 1974).

Raman and Brillouin scattering of an electromagnetic wave in an inhomogeneous, expanding plasma are studied. Application to laser–pellet irradiation is considered. (auth)

379 STIMULATED BRILLOUIN SCATTERING OF ELECTROMAGNETIC CIRCULARLY POLARIZED WAVES IN A MAGNETIZED PLASMA. Lee, K.F. (Department of Electronics, The Chinese University of Hong Kong, Shatin, N.T., Hong Kong). Phys. Fluids 17: No. 6, 1343-1345 (June 1974).

Stimulated scattering of electromagnetic waves of circular polarization incident on a magnetized plasma from ion waves propagating parallel to the external magnetic field is studied. The relevance of the process to ionospheric modification experiments is discussed. (auth)

380 SUPPRESSION OF IONIZATION WAVES BY HYDRODYNAMIC TURBULENCE. Attwood, D. (New York University, Bronx, New York 10453). Phys. Fluids 17: No. 6, 1341-1342 (June 1974).

Microwave scattering from density fluctuations in a dc discharge tube indicates that striations can be eliminated by hydrodynamic turbulence. (auth)

381 SOLUTION OF A GENERALIZED KORTEWEG–DE VRIES EQUATION. Tagare, S.G.; Chakrabarti, A. (Department of Applied Mathematics, Indian Institute of Science, Bangalore–560012, India). Phys. Fluids 17: No. 6, 1331-1332 (June 1974).

The solitary–wavelike solution of the generalized Korteweg–de Vries equation with mixed nonlinearity is obtained. Two asymptotic cases of the solution have been discussed and solitary wave solutions have been derived. (auth)

382 THEORY AND SIMULATION OF HIGHER–ORDER CYCLOTRON DAMPING. Gitomer, S.J.; Forslund, D.W. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Fluids 17: No. 7, 1428-1431 (July 1974).

The infinity of roots for real wavenumber k and complex frequency ω of the dispersion relation for transverse electromagnetic waves propagating in a thermal plasma parallel to an applied magnetic field B are studied theoretically and observed in numerical simulations. In addition to the usual weakly damped whistler and ion cyclotron roots, there are infinitely many more heavily damped electron (ion) roots characterized by real frequency near the gyrofrequency and damping rate proportional to the wavenumber. The electron modes have been observed in a thermal electromagnetic numerical simulation plasma and their dispersion agrees well with finite temperature linear theory. These modes may be observable experimentally. (auth)

383 MICROWAVE EMISSIONS FROM TURBULENT PLASMAS GENERATED IN A FAST, HIGH VOLTAGE THETA PINCH. Chin–Fatt, C. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Fluids 17: No. 7, 1410-1412 (July 1974).

Intense, and evidently nonthermal, bremsstrahlung has been observed from turbulent helium plasmas that were generated in a large, high voltage theta pinch operated in two different experimental configurations. The emissions were in the wavelength range 1 mm $\lesssim \lambda \lesssim$ 16 mm, and are identified as collective bremsstrahlung, originating from the interaction of longitudinal modes of the turbulent plasmas by wave–wave scattering. (auth)

384 SOLITONS AND RESONANT ABSORPTION. Valeo, E.J.; Kruer, W.L. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Rev. Lett. 33: No. 13, 750-753 (23 Sept 1974).

Simulations and theory of driven plasmas show the existence of long–lived, extremely intense spikes of high–frequency electric field, accompanied by a self–consistent depression in density. These entities are the limit to which solitons collapse in a driven plasma when the wave–particle interaction is included. Alterations in the density profile due to such entities is especially important for the absorption of radiation in inhomogeneous plasmas. (auth)

385 NONLINEAR SKIN EFFECT OF HIGH–POWER MICROWAVES INCIDENT ON A COLLISIONLESS MAGNETIZED PLASMA. Minami, K.; Singh, K.P.; Masuda, M. (Department of Electrical Engineering, Nagoya University, Nagoya, 464, Japan); Ishii, K. Phys. Rev. Lett. 33: No. 13, 740-743 (23 Sept 1974).

Experimental results are presented which verify a nonlinear skin effect of high–power microwaves incident on a collisionless, uniform plasma having a sharp boundary. The skin depth, observed by microwave reflection techniques, increases with the incident microwave power. (auth)

386 ELECTRON CYCLOTRON EMISSION FROM A TOKAMAK PLASMA: EXPERIMENT AND THEORY. Costley, A.E.; Hastie, R.J.; Paul, J.W.M.; Chamberlain, J. (United Kingdom Atomic Energy Authority Research Group, Culham Laboratory, Abingdon, Berkshire, United Kingdom). Phys. Rev. Lett. 33: No. 13, 758-761 (23 Sept 1974).

We present the first measurements of the power, polarization, and frequency spectrum of the electron cyclotron emission from a tokamak plasma. The radiation is not polarized, does not have the previously predicted spectrum, and under certain circumstances is an order of magnitude above the predicted power level. We interpret the results in terms of a scrambling of polarization on reflection within the torus and in terms of the emission from suprathermal electrons. (auth)

387 EFFECT OF PLASMA INHOMOGENEITY ON THE PRODUCTION OF ENERGETIC ELECTRONS. Klein, H.H.; Manheimer, W.M. (Naval Research Laboratory, Washington, D.C. 20375). Phys. Rev. Lett. 33: No. 16, 953-956 (14 Oct 1974).

Intense radiation impinging on a plasma near the critical density may be absorbed by exciting electrostatic plasma waves. In inhomogeneous plasmas these oscillations convect out of the interaction region to lower densities where the waves have lower phase velocities. Electrons whose velocity is not much greater than the thermal velocity then absorb the wave. In this process, a very few highly energetic electrons are produced. We present theory and simulation for the absorption of these waves in an inhomogeneous plasma. (auth)

388 NUMERICAL SIMULATION OF THE INTERACTION OF A STRONG WAVE WITH A MONODIMENSIONAL PLASMA. Colombant, D. (Centre d'Etudes de Limeil, Villeneuve-Saint-Georges, France). J. Phys. (Paris), Colloq.; No. 2, 1-3(1973). (In French).

From centenary congress of the French Physical Society; Vittel, France (28 May 1973).

Numerical calculations were carried out for simulation of high amplitude monochromatic wave electron plasma interaction, using a one-dimensional model. External wave frequency is twice plasma frequency. Parametric instability grows up from a certain threshold when taking into account spatial inhomogeneity of the applied external field. (FR)

389 PLASMA WAVES. Sanderson, J. J. pp 55-92 of Plasma Physics. Keen, B. E. (ed.). London; Inst. of Physics (1974).

Wave propagation of small amplitude plane waves in a cold, infinite, homogeneous, collisionless plasma is considered. Transverse and longitudinal waves in a field-free plasma, including parallel propagation (Alfven and ion cyclotron waves) and perpendicular propagation (compressional Alfven waves and hybrid resonances) in a magnetized plasma, and the general theory of waves in cold plasma are discussed. Waves known as whistlers or helicons and electron cyclotron, are considered. Some finite temperature modifications of the cold plasma theory are considered by adding pressure terms to the fluid equations. It is pointed out that there is a fundamental difference between cold and warm plasma theory in that whereas the cold plasma theory is properly a fluid theory, to describe warm plasma behavior the kinetic theory is needed. Waves in warm plasmas are then considered. (UK)

390 INTRODUCTORY NONLINEAR PLASMA PHYSICS. Franklin, R. N. (Oxford Univ.). pp 197-224 of Plasma Physics. Keen, B. E. (ed.). London; Inst. of Physics (1974).

Practicable fusion plasmas are likely to be turbulent and those of astrophysical interest certainly are. Such turbulent plasmas are nonlinear. Four basic types of nonlinearity are considered: (1) large amplitude effects; (2) interactions between linear processes such as waves; (3) interactions between waves propagating through plasmas and the particles which comprise those plasmas; (4) retention and loss of phase information or plasma wave echoes. (UK)

391 ADVANCED NONLINEAR THEORY OF PLASMAS. Cook, I. (Culham Lab., Abingdon, Eng.). pp 225-241 of Plasma Physics. Keen, B. E. (ed.). London; Inst. of Physics (1974).

Plasmas are considered which are predicted to be unstable on the basis of the linearized Vlasov equation. The unstable perturbations will grow until the linearization breaks down. Nonlinear theory is still in its infancy and analytical techniques of reasonably general application have not yet been evolved. However, by severely mutilating nonlinear phenomena they can be forced into linear theory and this approach is discussed here. The quasilinear theory is considered and quasilinear equations derived but it is concluded that it is difficult to understand the popularity of the theory since little can be learned from the equations that could not be inferred from the statement: "The growth of the fluctuations will modify the mean distribution function in such a way as to extinguish the instability." A simple model equation is proposed to simplify the manifestly nonlinear terms neglected in the quasilinear equation. It is concluded that there is still no convincing experimental confirmation or refutation of any of the ideas discussed. The subject is still in its early days but it is considered that the difficulties will rapidly be overcome. (UK)

392 NONLINEAR EVOLUTION OF AN ION WAVE PACKET IN A PLASMA. Watanabe, S. (Paris-11 Univ., 91-Orsay (France). Lab. de Physique des Plasmas). Phys. Lett., A; 48: No. 6, 457-458(29 Jul 1974). (In French).

A plasma (pressure 10^{-4} torr, density about 2×10^{9} cm^{-3}, temperature about 2 eV) was created in argon by a dc discharge, and confined by a multipole magnetic field. The propagation of perturbations generated by a positive pulse applied to a fine grid was studied. Instability of the envelope and self-trapping of the ion wave packet were observed. (auth)

393 DAMPED CYCLOTRON HARMONIC WAVES AT OBLIQUE PROPAGATION. Meyer, R. L.; Leclert, G. (Nancy-1 Univ., 54 (France). Lab. de Physique des Milieux Ionises). Phys. Lett., A; 48: No. 6, 411-412(29 Jul 1974).

The dispersion relation of CHW at oblique propagation in a wave magnetoplasma exhibits many damped roots between two successive cyclotron harmonics. The two less damped are those obtained by Tataronis and Crawford. (auth)

ENGINEERING

Energy Conversion

Refer also to abstracts 199, 200, and 350.

394 (AD-780215) DESIGN GUIDE FOR RADIOISOTOPE POWER GENERATOR PRESSURE VESSELS. Final report, December 1972–January 1974. Finn, B. M. (Naval Ordnance Lab., White Oak, Md. (USA)). 6 Feb 1974. 89p. NTIS $4.00.

The guide is the end product of an engineering investigation to establish criteria and inspection procedures to assure long term structural and watertight integrity for radioisotope power generator (RPG) pressure vessels. The suggested construction of the RPG consists of a cylindrical pressure housing with either two formed torospherical end closures circumferentially edge welded to the housing or a flanged housing to which a formed end closure is bolted. The materials of construction are comprised of alloys of nickel, copper and titanium with the Hastelloy Alloy C-276 being the preferred choice. The design of the electrical penetrator follows that suggested in the "Handbook of Vehicle Penetrators, connectors and Harnesses For Deep Ocean Applications." The testing requirements consist of design verification tests for the electrical penetrators and sequential hydrostatic and leak testing of the RPG pressure vessel. The hydrostatic tests should be performed at 1.5 times design operating pressure. (auth)

395 COST-EFFECTIVE RADIOISOTOPE THERMOELECTRIC GENERATOR DESIGNS INVOLVING ^{244}Cm AND ^{238}Pu HEAT SOURCES. Eggers, P. E.; Ridihalgh, J. L. (Battelle Columbus Labs., OH). J. Spacecraft Rockets; 11: No. 10, 704-709(Oct 1974).

A comparative analysis is presented of some of the technical considerations surrounding the use of ^{244}Cm and ^{238}Pu heat sources in radioisotope thermoelectric generators (RTGs). The principal considerations include radiological shielding, ground handling, and generator performance characteristics. A novel approach to RTG design and qualification is described which would facilitate the use of ^{244}Cm heat sources. This approach, which involves hermetically sealed bellows-encapsulated thermoelectric elements, also features the potential for increased generator output power stability and reliability and lower converter costs accruing from the advantages of a standardized approach to generator design, fabrication, and qualification. (auth)

396 BEGINNING OF MISSION FLIGHT DATA ON THE TRANSIT RTG. Bradshaw, G. B.; Postula, F. D. (General Atomic Co., San Diego, CA). J. Spacecraft Rockets; 11: No. 10, 675-676(Oct 1974).

The transit RTG (Radioisotope Thermoelectric Generator) was launched aboard a Scout missile on Sept. 2, 1972, into a nearly circular polar orbit (~425 naut miles), to provide the primary power for a Navy Navigational Satellite with a design lifetime of five years. Electrical and thermal data were obtained on the RTG during ascent and for the first month in space and are presented in this paper. Temperature drop across the insulation is a nominal 264°C with an orbital spread of ±3°C, which compares exactly to laboratory data at the same operating conditions and verifies integrity of the multifoil insulation in space. (auth)

397 LARGE ENTHALPY EXTRACTION EXPERIMENTS IN A NONEQUILIBRIUM MAGNETOHYDRODYNAMIC GENERATOR. Tate, E.; Marston, C.H.; Zauderer, B. (General Electric Company, Space Sciences Laboratory, King of Prussia, Pennsylvania 19406). Appl. Phys. Lett. 25: No. 10, 551-553 (15 Nov 1974).

A measure of the performance of a magnetohydrodynamic (MHD) generator is the enthalpy extraction (power out/heat in) which generally must exceed 20% to operate efficiently in a thermodynamic Brayton power cycle. For the first time 1.82 MW which represented 19.3% enthalpy extraction, was achieved in a nonequilibrium plasma MHD generator. Cold electrodes were used. Theoretical calculations show that 30% enthalpy extraction could be achieved with thermionically emitting electrodes. (auth)

398 PROCEEDINGS OF THE 25TH POWER SOURCES SYMPOSIUM, 23–25 MAY 1972. Red Bank, NJ; PSC Publications Committee (1972). 202p. (CONF-720527-).

From 25th power source symposium; Atlantic City, New Jersey, USA (23 May 1972).

A separate abstract was prepared for one paper presented at the conference. The remaining papers were not in scope for NSA. (RCK)

For an abstract of an individual paper see: 399.

399 ISOTOPE MINATURE POWER SYSTEM (IMPS). Bustard, T. S. (Nuclear Battery Corp., Columbia, MD). pp 114-117 of Proceedings of the 25th Power Sources Symposium. Red Bank, NJ; PSC Publications Committee (1972).

From 25th power source symposium; Atlantic City, New Jersey, USA (23 May 1972). See CONF-720527-.

A small nuclear power source tradenamed IMPS has been developed. The unit is fueled with 1.35 watts (t) of plutonium-238 in the form of PuO_2 and employs a small bismuth telluride thermoelectric module to convert the decay heat of the radioisotope directly into electricity. The IMPS output is a constant 35 mwatts (e) at 1.3 to 1.5 volts. The unit is small and cylindrical, measuring 0.75 inch in diameter by 2.6 inches long, and it weighs a nominal 4 ounces. It is readily handleable, both from thermal and radiation standpoints, having a maximum external temperature of 115°F in a 75°F ambient and a surface dose rate of 250 mrem/hr. To date the cumulative operating life of these sources is approximately 200,000 hours. The oldest unit has operated for more than 11,000 hours with no change in output characteristic. The units have been thoroughly tested in shock and vibration and for thermal response. They have survived 0 to 2000 Hz vibration, shocks in excess of 2000 g's, and thermal cycling to 160°F ambient temperature. (auth)

Facilities and Equipment

Refer also to abstracts 340 and 1289.

400 (AD-776564) FREQUENCY STABILIZATION OF A RING LASER. Basov, N. G.; Belenov, E. M.; Volnov, M. I.; Gubin, M. A.; Nikitin, V. V. Translated by J. T. Eros from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 11, 659-661(1972). 5p. NTIS $3.00.

Results are given of an experiment for creating the optical ($\lambda = 3.39$ microns) standard of a frequency with a relative frequency stability of delta $nu/nu = 5 \times 10^{-14}$. (GRA)

401 (AD-776748) POSSIBILITY OF DEVELOPING PULSE GAS LASERS WITH PUMPING BY AN ELECTRON BEAM IN AN ELECTRIC FIELD. Afanasev, Yu. V.; Belenov, E. M.; Bogdankevich, O. V.; Danilychev, V. A.; Darznik, S. G. Translated by R. D. Hill from Vysokomol. Soedin., Ser. B; No. 11, 23-27(Nov 1970). 10p. (FTD-HT-23-716-74). NTIS $3.00.

A report is given concerning the possibility of developing pulsed gas lasers with combined excitation when the pumping of the gas is produced simultaneously by an electron beam in an electric field. The proposed method of excitation fundamentally allows obtaining the high radiation power of laser owing to the uniform excitation at high pressures of large gas volumes. The role of the electron beam is actually reduced to the creation of conditions for a streamerless development of a discharge, and the excitation energy comes basically from the external electric field. (GRA)

402 (AD-777162) REACTING FLOW AND PRESSURE RECOVERY PROCESSES IN HF/DF CHEMICAL LASERS. Report for September 1969–September 1973. Warren, W. R. Jr. (Aerospace Corp., El Segundo, Calif. (USA)). 30 Nov 1973. Contract F04701-73-C-0074. 45p. (SAMSO-TR-74-68). NTIS $3.25.

Several properties of gasdynamic processes that occur in flowing gas lasers are discussed and their importance in establishing laser performance is outlined. The continuous HF (or DF) supersonic diffusion chemical laser is chosen to illustrate the coupling between chemical energy release and fluid dynamics in a laser of current interest. A simplified quasi-one-dimensional analysis is used to illustrate the energy release rates in different parts of a combustion-heated DF laser. The complex nature of the reacting mixing flow in the lasing zone is described, and the properties of the initial reaction generated shock waves in the flow are estimated through a displacement thickness analysis. Finally, a partial constant area concept for use with a supersonic diffusion chemical laser is analyzed. (auth)

403 (AD-778325) DEVELOPMENT OF METAL HALIDE LASERS. Final Report, 1 July 1972–1 June 1973. Zare, R. N. (Columbia Univ., New York (USA). Dept. of Chemistry). 1 Jun 1973. Contract N00014-67-A-0108-0035. 69p. NTIS $6.50.

Work was initiated to assess the feasibility of constructing a visible laser employing electronically excited metal halide molecules as an active media. Special attention was focused on the Group IIA Metal Monohalides. Fluorescence intensity versus time was plotted and a method for measuring radiative lifetime developed. (GRA)

404 (KFKI-74-61) DISTRIBUTED FEEDBACK X-RAY LASER ARRANGEMENT PROPOSAL IN PREPLASMA STATE. Farkas, Gy.; Horvath, Z. Gy. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1974. 9p. Dep. NTIS (U. S. Sales Only) $4.00.

The principle of distributed feedback (DFB) lasers is proposed in the x-ray wavelength range using monocrystals, with convenient Laue-planes. Several crystals, fulfilling the DFB condition for their characteristic wavelength, are suggested. It was concluded from photoelectron emission experiments, that the x-ray laser process may take place before destroying the crystal structure. (auth)

405 (LA-5676-MS) OPTIMUM VIBRATIONAL EXCITATION OF CO MOLECULES IN CO–N_2 MIXTURES. Rockwood, S. D. (Los Alamos Scientific Lab., N. Mex. (USA)). Jul 1974. Contract W-7405-eng-36. 6p. Dep. NTIS $4.00.

Vibrational excitation rates for CO and N_2 mixtures were obtained from numerically computed electron energy distributions. It is found that the CO excitation rate may be enhanced by the addition of N_2. The optimum fraction of CO is found to be 30% at $E/N = 1.5 \times 10^{-16}$ V-cm^2 and increases to 60% at $E/N = 4.0 \times 10^{-16}$ V-cm^2. (auth)

406 (LA-UR-74-1328) INITIATIVES OF THE LOS ALAMOS SCIENTIFIC LABORATORY IN THE TRANSFER OF A NEW EXCAVATION TECHNOLOGY. Hanold, R. J.; Bankston, C. A.; Rowley, J. C.; Long, W. W. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. 12p. (CONF-740938-1). Dep. NTIS $4.00.

From world conference on toward a plan of actions for mankind: needs and resources–methods of prevision; Paris, France (9 Sep 1974).

The Los Alamos Scientific Laboratory's charter requires that the technical facilities and staff be capable of a broad range of activities ranging from basic science to the design, fabrication, and testing of intricate systems and devices. Research activities on metal and graphite core nuclear propulsion reactors (AEC/NASA Rover Program) resulted in significant high temperature materials science technology developments. These capabilities were recently applied to excavation technology through the introduction of a rock-melting penetrator system. Rock melting was recognized as an innovation that simultaneously attacks the three major problems of excavation, namely rock fracturing, debris removal, and wall stabilization, with an inherently integrated system. The technology transfer efforts of the laboratory have been aimed at commercial producers and users of excavation equipment as well as customers for excavations. Initiatives in the technical area have included solicitation of industrial input, industrial participation through staff exchange and joint ventures, industrial and academic input through the formation of advisory panels, and the publication of numerous technical reports and papers. Initiatives to inform the commercial sector and the public of the potential usefulness of rock melting have included public demonstrations, permanent and temporary displays, and visits and talks with all segments of society and commerce. LASL's experience in these technology transfer initiatives and the dissemination of technological achievements which result from federally funded R&D projects are discussed. (auth)

407 OPERATION OF A 15-ATM ELECTRON-BEAM-CONTROLLED CO_2 LASER. Harris, N. W.; O'Neill, F.; Whitney, W. T. (Naval Research Lab., Washington, DC). Appl. Phys. Lett.; 25: No. 3, 148-151(1 Aug 1974).

Stable glow discharges were sustained in the high-pressure He : CO_2 : N_2 mixtures for 0.5 μsec using an electron-beam current of $\lesssim$1.5 A/cm^2. A small-signal gain ~0.052 cm^{-1} was measured in a 70%(He) : 25% (CO_2) : 5% (N_2) mixture for an energy input to the gas ~115 J/1 atm. A laser-output energy of 1.2 J was obtained from a volume of 22 cm^3 for an over-all efficiency of 2.5%. (auth)

408 OPTICALLY EXCITED ORGANIC DYE VAPOR LASER. Smith, P. W.; Liao, P. F.; Shank, C. V.; Gustafson, T. K.; Lin, C.; Maloney, P. J. (Bell Telephone Lab., Holmdel, NJ). Appl. Phys. Lett.; 25: No. 3, 144-146(1 Aug 1974).

The observation of laser action in an organic scintillator dye vapor (POPOP) is reported. The dye was heated in a suitable oven and the vapor excited with the 3371-Å radiation from a pulsed N_2 laser. 30 kW of laser output at 3930 Å was obtained at a dye temperature of 330°C. (auth)

409 DYNAMIC MODEL OF HIGH-PRESSURE RARE-GAS EXCIMER LASERS. Werner, C. W. (Massachusetts Inst. of Tech., Cambridge); George, E. V.; Hoff, P. W.; Rhodes, C. K. Appl. Phys. Lett.; 25: No. 4, 235-238(15 Aug 1974).

The dynamic behavior of the high-pressure rare-gas vuv excimer systems was examined. It was found that the collisional coupling of the excited singlet and triplet manifolds in combination with the losses arising from photoionization play a vital role in determining the over-all performance. The proposed mechanisms provide a unified description of both the pressure dependence of the stimulated output and the observed pressure shift of the stimulated spectrum in xenon. Numerical values of the relevant parameters are given. (auth)

410 EVALUATION OF CaLaSOAP : Nd FOR HIGH-POWER FLASH-PUMPED Q-SWITCHED LASERS. Steinbruegge, K. B. (Westinghouse Research Labs., Pittsburgh); Baldwin, G. D. Appl. Phys. Lett.; 25: No. 4, 220-222(15 Aug 1974).

Pump-induced thermal lensing and bifocusing were measured for flash-pumped CaLaSOAP : Nd, together with long-pulse Q-switched laser efficiencies. The results show that CaLaSOAP : Nd maintains its high efficiency in the Q-switched mode, that it is capable of average power operation exceeding 1 J at 30 pps, and that bifocusing is less severe in CaLaSOAP : Nd than in YAG : Nd. (auth)

411 SUCCESSFUL LIQUID PHASE EPITAXIAL GROWTH AND OPTICALLY PUMPED LASER OPERATION OF $In_{0.5}Ga_{0.5}P$–$Ga_{0.4}Al_{0.6}As$ DOUBLE-HETEROSTRUCTURE MATERIAL. Miller, B. I.; Johnston, W. D. Jr. (Bell Telephone Labs., Inc., Murray Hill, NJ). Appl. Phys. Lett.; 25: No. 4, 216-218(15 Aug 1974).

The preparation by liquid phase epitaxy of laser-quality $Al_yGa_{1-y}As/In_{0.49}Ga_{0.51}P/Al_yGa_{1-y}As$ double-heterostructure material is reported. The structure provided optical waveguiding and carrier confinement for $y \gtrsim 0.6$. Cleaved bars have shown laser action at ~6200 Å, when optically pumped in the temperature range 77 to 130°K. The lasing threshold is 50% higher than for geometrically similar high-quality $Al_{0.5}Ga_{0.5}As/GaAs/Al_{0.5}Ga_{0.5}As$ laser material. (auth)

412 HIGH-PRESSURE PULSED MOLECULAR LASERS. Wood, O. R. II. (Bell Telephone Labs., Holmdel, NJ). Proc. IEEE (Inst. Elec. Electron. Eng.); 62: No. 3, 355-397(Mar 1974).

A review of recent developments in high-pressure pulsed molecular lasers is presented. Included are some experimental results on TEA lasers, E-beam lasers, and lasers using Blumlein excitation. Discussions of the kinetic modeling, the parametric behavior, and the characteristics of uniform discharges in the high-pressure pulsed CO_2 laser are given. Recent results on pulse-initiated chemical lasers, extremely high-pressure lasers, and high-repetition-rate TEA lasers are also discussed. Efforts to control and use the output from these devices are described, and an extensive list of references is given. (auth)

413 He–Cd–Se LASER. S'botinov, N. V.; Telbizov, P. K.; Kalchev, S. D. (Inst. of Solid-State Physics, Sofia). Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 12, 1646-1650 (Jun 1974).

Translated from Zh. Tekh. Fiz.; 43: No. 12, 2621-2624(Dec 1973).

A new gas laser is described. It lases individually and simultaneously on the following spectral lines: Cd II (4416 Å), and Se II (4976, 4992, 5068, 5176, and 5227 Å). Two versions are described and an investigation of the He–Cd–Se laser is presented. (auth)

414 MECHANISM OF DEVELOPMENT OF GENERATION POWER IN RUBY LASERS WITH SELF-MODULATION. Borisov, V. I.; Lebedev, V. I. Zh. Prikl. Spektrosk.; 20: No. 6, 987-989 (Jun 1974). (In Russian).

A photographic method is described for recording the radiation intensity of a laser beam over a wide range of intensities and duration of generation. The method is based on the rate of photographing the succession of beams obtained by splitting a laser beam of a plane parallel glass plate. Study of the development of generation power in a ruby laser spontaneously generating gigantic pulses showed the nonexponential nature of the forward front of the pulses and the build-up of generation peaks. The data indicate a dependence of the quality of the laser resonator, operating in such a regime, on the radiation intensity. (tr-auth)

415 OPTICAL EFFICIENCY OF COAXIAL SYSTEMS FOR PUMPING LIQUID LASERS. Zhuravleva, L. N.; Kromskii, G. I.; Shcherbakov, A. A. Zh. Prikl. Spektrosk.; 20: No. 6, 981-986 (Jun 1974). (In Russian).

Theoretical studies were made of the optical efficiency and components of the energy balance of coaxial systems for pumping liquid lasers. The dependence of the efficiency on the absorption properties of the active medium and the plasma of the source and on their geometric dimensions was analyzed. From the results it was possible to determine, for practical purposes, the geometrical and physical properties of the source of pumping and the active substance determining the field of effective operation of the pumping system. (tr-auth)

416 STUDY OF THE He–Ne LASERS WITH CONE-SHAPED DISCHARGE TUBES. Fedotov, A. A.; Chernigovskii, V. V. Zh. Prikl. Spektrosk.; 20: No. 6, 1085-1087(Jun 1974). (In Russian).

The increase in the gain coefficient for gaseous lasers with cone-shaped tubes was calculated approximately, and experimental data are given which show that the power of such lasers is 30 to 70% greater than that of lasers with cylindrical tubes. (tr-auth)

417 SOME ENVIRONMENTAL PROBLEMS WITH THE USE OF RESOURCES. Hasegawa, Y. (Inst. for Future Tech., Tokyo). Genshiryoku Kogyo; 20: No. 2, 21-25(Feb 1974). (In Japanese).

Human beings have sought energy resources in the natural environment, consumed and then discarded the residuum into it; that is, nature has been treated both as source and sink, and the natural environment has been understood as that outside human social system. When the recent developments including exponential increase of human activities, the depletion of natural resources and the destruction of the natural environment are at issue, however, human beings have noticed at long last the finiteness of the natural environment. In face of this situation, the whole problem must be reconsidered. The following are reviewed: characteristic features of environmental problems, utilization of nuclear power and environmental problems, energy consumption and environmental problems, and the limitation in utilizing energy resources. (JA)

418 THICK-WALLED MICROPOLAR CYLINDER IN A STATE OF PLANE STRAIN. Baluch, M. H. (Tennessee State Univ., Nashville (USA)); Korman, T.; Goldberg, J. E.; Morghem, F. T. (Purdue Univ., Lafayette, Ind. (USA)). Nucl. Eng. Des.; 30: No. 1, 93-96(Jul 1974).

The important boundary value problem of a thick-walled micropolar cylinder loaded with an internal pressure is discussed. Use is made of a finite element model to study the influence of the micropolar characteristics on the stresses and displacements in the cylinder. (auth)

419 ON THE USE OF VARIOUS SHELL THEORIES IN THE ANALYSIS OF AXISYMMETRICALLY LOADED CIRCULAR CONTAINERS. Goldberg, J. E.; Korman, T. (Purdue Univ., Lafayette, Ind. (USA)); Baluch, M. H. (Tennessee State Univ., Nashville (USA)). Nucl. Eng. Des.; 30: No. 1, 88-92(Jul 1974).

In shell literature there are several theories concerning the behavior of thin shells and a few regarding the behavior of thick and moderately thick shells. An attempt is made to bridge the gap that exists in the practicing engineer's mind as to when the validity of the theory of thin shells ceases and when that of thick shells begins. The problem of an axisymmetrically loaded container in the form of a cylindrical shell is analyzed, using both thick and thin shell theories for various values of t/R and a recommendation is made regarding the bifurcation point between thin and thick shell theories. (auth)

420 INSTRUMENTATION FOR USE IN PRESTRESSED-CONCRETE REACTOR PRESSURE VESSELS. Czaika, N. Exp. Mech.; 14: No. 2, 82-88(Feb 1974).

A detailed review of stress and strain measurement techniques is given with respect to the application in concrete reactor pressure vessels (PCRV). The working conditions of gages are extremely difficult because of radiation and elevated temperature. Besides, a high degree of reliability is expected. Valuable information on the construction of gages and their sensitivity is given when the electrical, fluidic, and mechanical-measuring methods are considered. The paper is of importance for engineers preparing tests and measurements of PCRV's. (Appl. Mech. Rev.)

421 SPECIFICATION FOR CORROSION-RESISTING CHROMIUM AND CHROMIUM–NICKEL STEEL WELDING RODS AND BARE ELECTRODES. AWS A5.9-69. New York; American Welding Society, Inc. (1969). 19p. (ICONS-01837). $2.00.

This specification covers corrosion-resisting chromium and chromium–nickel steel welding rods for use with the atomic hydrogen and gas–tungsten-arc welding processes and bare electrodes for use with the submerged arc and gas metal-arc welding processes. These welding rods and electrodes include those alloy steels designated as corrosion- or heat-resisting chromium and chromium–nickel steels, in which chromium exceeds 4% and nickel does not exceed 50%. (auth)

422 SPECIFICATION FOR NICKEL AND NICKEL-ALLOY BARE WELDING RODS AND ELECTRODES. AWS A5.14-69. New York; American Welding Society, Inc. (1969). 19p. (ICONS-01833). $2.00.

This specification prescribes requirements for nickel and nickel-alloy bare filler metal (welding rods and electrodes) for use with the oxy-acetylene, atomic hydrogen, gas metal-arc, gas tungsten-arc, and submerged-arc welding processes, as applicable. (auth)

423 SPECIFICATION FOR COPPER AND COPPER-ALLOY ARC-WELDING ELECTRODES. AWS A5.6-69. New York; American Welding Society, Inc. (1969). 19p. (ICONS-01827). $2.00.

This specification prescribes requirements for solid and stranded bare and covered copper and copper-alloy arc-welding electrodes for use with the manual shielded metal-arc, gas metal-arc, and submerged arc welding processes. (auth)

424 SPECIFICATION FOR BRAZING FILLER METAL. AWS A5.8-69. New York; American Welding Society, Inc. (1969). 23p. (ICONS-01839). $2.00.

This specification prescribes requirements for filler metals which are added when making a braze. The compositions are selected to include those having different brazing properties as well as those having important commercial application. (auth)

425 SPECIFICATION FOR MILD STEEL ELECTRODES FOR FLUX-CORED ARC WELDING. AWS A5.20-69. Miami, FL; American Welding Society, Inc. (1969). 27p. (ICONS-01836).

This specification prescribes requirements for mild steel composite electrodes for flux cored arc welding of mild and low alloy steels. (auth)

426 SPECIFICATION FOR CORROSION-RESISTING CHROMIUM AND CHROMIUM–NICKEL STEEL COVERED WELDING ELECTRODES. AWS A5.4-69. New York; American Welding Society, Inc. (1969). 24p. (ICONS-01825). $2.00.

This specification prescribes requirements for covered chromium and chromium–nickel steel electrodes yielding deposited weld metal in which chromium exceeds 4% and nickel does not exceed 50%. (auth)

427 SPECIFICATION FOR LOW-ALLOY STEEL COVERED ARC-WELDING ELECTRODES. AWS A5.5-69. Miami, FL; American Welding Society, Inc. (1969). 43p. (ICONS-01826). $3.00.

This specification prescribes requirements for covered low-alloy steel electrodes for shielded metal-arc welding of carbon and low-alloy steels. (auth)

428 SPECIFICATION FOR COPPER AND COPPER-ALLOY WELDING RODS. AWS A5.7-69. New York; American Welding Society, Inc. (1969). 23p. (ICONS-01838). $2.00.

This specification prescribes requirements for copper and copper-alloy welding rods for use with the oxyacetylene, and gas tungsten-arc welding processes. (auth)

429 SPECIFICATION FOR ALUMINUM AND ALUMINUM ALLOY WELDING RODS AND BARE ELECTRODES. AWS A5.10-69. New York; American Welding Society, Inc. (1969). 23p. (ICONS-01830). $2.00.

This specification prescribes requirements for aluminum and aluminum-alloy welding rods for use with the gas and gas tungsten-arc welding processes and bare electrodes for use with the metal-arc welding process. (auth)

430 SOUND CONTROL OF MECHANICAL EQUIPMENT FOR REFINERY SERVICES. API Standard 615. Washington, DC; American Petroleum Institute (1973). 8p. (ICONS-01847). $1.00.

This specification is intended to satisfy the sound limit requirements of the Occupational Safety and Health Act of 1970 for machines located in main plant areas. The purchaser will specify the sound limit applicable to his facility normally selected from the current limits for occupational noise exposure. For convenience the 1970 levels are reproduced from the Federal Register in tabular form. (auth)

431 SPECIFICATION FOR BARE MILD STEEL ELECTRODES AND FLUXES FOR SUBMERGED-ARC WELDING. AWS A5.17-69. Miami, FL; American Welding Society, Inc. (1969). 23p. (ICONS-01834).

This specification prescribes requirements for bare mild steel electrodes and fluxes for submerged arc welding of mild and low-alloy steels. (auth)

432 SPECIFICATION FOR SURFACING WELDING RODS AND ELECTRODES. AWS A5.13-70. Miami, FL; American Welding Society, Inc. (1970). 39p. (ICONS-01832).

This specification prescribes requirements for straight length bare and covered surfacing welding rods for use with the oxy-acetylene, gas tungsten-arc, carbon-arc and atomic hydrogen welding processes. This specification also covers straight length bare and covered surfacing electrodes for use with the shielded metal-arc welding process. (auth)

433 SPECIFICATION FOR FLUX CORED CORROSION-RESISTING CHROMIUM AND CHROMIUM–NICKEL STEEL ELECTRODES. AWS A5.22-74. Miami, FL; American Welding Society, Inc. (1974). 35p. (ICONS-01828).

This specification prescribes requirements for flux cored corrosion-resisting chromium and chromium–nickel steel electrodes. These electrodes are normally used for flux cored arc welding, and include those alloy steels designated as corrosion or heat-resisting chromium and chromium–nickel steels, in which chromium exceeds 4.0% and nickel does not exceed 50.0%. (auth)

434 SPECIFICATION FOR MILD STEEL COVERED ARC-WELDING ELECTRODES. AWS A5.1-69. Miami, FL; American Welding Society, Inc. (1969). 43p. (ICONS-01822).

This specification prescribes requirements for covered mild steel electrodes for shielded metal-arc welding of carbon and low-alloy steels. (auth)

435 GUIDELINES FOR THE DOCUMENTATION OF DIGITAL COMPUTER PROGRAMS. Hinsdale, IL; American Nuclear Society (1974). 10p. (ICONS-01840; ANSI-N-413-1974). $7.50.

This standard presents guidelines for the documentation of engineering and scientific computer programs. Good documentation promotes understanding, reduces duplication of effort, eases conversion to different computer environments and aids modification for extended applications. Good documentation is essential for implementation and effective use of programs obtained from other installations. Since the intention of this standard is to encourage better communication between the developer and user, it should be regarded as a guide rather than a set of rigid specifications. As a guide, it is sufficiently comprehensive to apply to large-scale programs intended for extensive external use. Not all features of this document are appropriate in all circumstances. For example, programs in the initial experimental stage would not be expected to require as extensive documentation as outlined in this standard. The degree of conformance is a matter of judgment and must be decided for each individual situation by the management of the development effort. In general, as the project complexity increases so does the need for more complete documentation. An organization may have special documentation requirements which supersede or extend these guidelines. This standard is a revision of ANS-STD.2-1967 and supersedes it. (auth)

436 RECOMMENDED RULES FOR DESIGN AND CONSTRUCTION OF LARGE, WELDED, LOW-PRESSURE STORAGE TANKS. API Standard 620. Washington, DC; American Petroleum Institute (1973). 129p. (ICONS-01846). $3.00.

These rules are intended to cover the design and construction of large, welded, low-pressure, carbon steel, aboveground storage tanks which have a single vertical axis of revolution and are operated at metal temperatures not greater than 200°F and with pressures in their gas or vapor spaces exceeding those permissible under API Standard 650: Welded Steel Tanks for Oil Storage (formerly API Standard 12C), but not exceeding 15 psig. Provision is made for installations in areas where the lowest recorded one-day mean atmospheric temperature is as low as –50°F. Appendix R covers low-pressure storage tanks for refrigerated products from +40 to –60°F. Appendix Q covers low-pressure storage tanks for liquefied hydrocarbon gases to temperatures not lower than –270°F. These rules may be used for tanks intended either for holding or storing liquids with gases or vapors above the surface of the liquid or for holding or storing gases or vapors alone, but do not apply to "lift-type" gas holders. Although these rules are not intended to cover horizontal tanks, they are not intended to preclude the application of appropriate portions hereof to the design and construction of horizontal tanks designed in accordance with good engineering practice, in which the details not covered by these rules are no less safe than the design and construction provided herein for tanks of the shapes expressly covered. (auth)

437 WELDING SYMBOLS. AWS A2.0-68. Miami, FL; American Welding Society, Inc. (1968). 95p. (ICONS-01823).

Symbols are presented for placing complete welding instructions on drawings. (TFD)

438 SPECIFICATION FOR NICKEL AND NICKEL-ALLOY COVERED WELDING ELECTRODES. AWS A5.11-69. New York; American Welding Society, Inc. (1969). 27p. (ICONS-01831). $2.00.

This specification prescribes requirements for nickel and nickel-alloy covered electrodes for shielded metal-arc welding. (auth)

439 STRUCTURAL WELDING CODE. AWS D1.1-72. Miami, FL; American Welding Society, Inc. (1972). 150p. (ICONS-01842). $16.00.

This code covers welding requirements as they apply to any type of welded structure and is to be used in conjunction with any complementary code or specification for the design and construction of steel structures. It is not intended to apply to pressure vessels or pressure piping. Requirements that are essentially common to all structures are covered in Sections 1 through 7 while provisions applying exclusively to Buildings (static loading), Bridges (dynamic loading), or Tubular Structures are included in Sections 8, 9, and 10 respectively. For abstracts of the 1973 and 1974 revisions to this code see ICONS-01844 and ICONS-01841, respectively. (TFD)

440 STRUCTURAL WELDING CODE. 1973 Revisions. AWS D1.1Rev 1-73. Miami, FL; American Welding Society, Inc. (1973). 140p. (ICONS-01844).

The 1973 revisions to the 1972 Structural Welding Code are presented. For abstracts of the original code and the 1974 revisions see ICONS-01842 and ICONS-01841, respectively. (TFD)

441 STRUCTURAL WELDING CODE. 1974 Revisions. AWS D1.1-Rev 2-74. Miami, FL; American Welding Society, Inc. (1974). 143p. (ICONS-01841).

The 1974 revisions to the 1974 Structural Welding Code are presented. For abstracts of the original code and the 1973 revisions see ICONS-01842 and ICONS-01844, respectively. (TFD)

442 RECENT DEVELOPMENTS IN THE FIELD OF THERMALLY INDUCED WAVES AND VIBRATIONS. Bargmann, H. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Eng. Des.; 27: No. 3, 372-385(Jul 1974).

A review of the work done during the last few years on the dynamic interaction between thermal fields and solid bodies is presented. In most of the problems, elastic behavior is assumed, but memory effects, both in the mechanical and thermal response (i.e., viscoelasticity and second sound), are also discussed. This reflects the intense interest which has been shown recently in this field, owing to the great practical importance of dynamic effects in modern aeronautics and astronautics, nuclear reactors, high-energy particle accelerators, and its potential importance in cryogenic applications. First, a brief summary of the general theory of continuum thermomechanics is given. Second, problems of thermoelasticity, i.e., problems of thermoelastic coupling and surface and radiation heating, are reviewed. Memory effects in the mechanical or thermal response, i.e., thermoviscoelasticity and second sound, are discussed. Recent generalizations of the Clausius-Duhem inequality are reviewed, and references are made to thermoplastic and magneto-thermoelastic waves. Finally, general methods of solution are discussed. An extensive bibliography is included. (auth)

443 DYNAMIC PLASTICITY. Lee, L. H. N. (Notre Dame Univ., Ind. (USA)). Nucl. Eng. Des.; 27: No. 3, 386-397(Jul 1974).

Dynamic plasticity is concerned with the studies of motion and permanent deformation of various inelastic solids under high rates of loading. A review of developments in this field during the last five years is presented. The field involves many unsettled physical and mathematical problems chiefly in connection with the physical foundations of continuum constitutive relationships for large ranges of stress intensity, strain rate and temperature variations, and with the solutions of boundary and initial value problems of nonlinear or quasi-linear systems of partial differential equations. Notwithstanding the difficulties, substantial progress has been made in many areas of the field including interaction of loading and unloading waves in thin rods, waves of combined stresses, plane, cylindrical and spherical waves, extremum principles, bounding theorems, and inelastic, dynamic behavior of strings, rings, beams, frames, plates and shells. (auth)

444 DYPLAS, A FINITE ELEMENT DYNAMIC ELASTIC-PLASTIC LARGE DEFORMATION ANALYSIS PROGRAM. Zudans, Z.; Reddi, M. M.; Tasi, H.-C. (Franklin Inst. Research Labs., Philadelphia, Pa. (USA)). Nucl. Eng. Des.; 27: No. 3, 398-412(Jul 1974).

DYPLAS is a computer program designed to compute the response history of general three-dimensional structures subjected to transient thermal and mechanical loadings. The analysis considers nonlinearities arising from material behavior as well as from large deformations that may occur in the structure. Elastic-plastic behavior with isotropic hardening is included by means of incremental relations of the Prandtl-Reuss type combined with a variant of the "plastic strain-total strain" method. Reduction of the constitutive relations to the case of generalized plane stress is also presented. Spatial discretization is achieved by applying the displacement formulation of the finite element method. In order to achieve reasonable computational time, the number of computational points used in the algorithm for numerical integration over the volume of each finite element required minimization; a triangular, flat-plat bending element is cited as an example for which this minimization was achieved satisfactorily. An explicit scheme is used for computation of dynamic response. With this scheme, formation of a global stiffness matrix is not needed. Consequently, the usual limitations arising from bandwidth or problem size are completely eliminated. (auth)

445 SPECIFICATION FOR MILD STEEL ELECTRODES FOR GAS METAL-ARC WELDING. AWS A5.18-69. Miami, FL; American Welding Society, Inc. (1969). 27p. (ICONS-01835).

This specification prescribes requirements for mild steel, solid electrodes for gas metal-arc welding of mild and low alloy steel. (auth)

Lasers

Refer also to abstract 1654.

446 (AD-776349) MICROWAVE EXCITATION OF LASER GASES. Durham, D. R. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio (USA). School of Engineering). Mar 1974 112p. (GEP/PH-74-5). NTIS $8.75.

Thesis.

The goal of this experiment was the creation of large numbers of electrons and helium (12 triplet S) metastables through the use of four microwave cavity discharges. The desire for gas ionization independent of the exciting field stems from (1) the increased efficiency available when lower exciting fields can be used, and (2) the stabilizing effect of independent electron density control. The desire for helium metastable production stems from (1) additional electron creation via Penning ionization in a helium afterglow, and (2) increased metal-vapor laser pumping efficiency. The effective increase of the recombination coefficient due to electron cooling by added nitrogen was shown. The discovery of negative absorption of the 3889A line in a pure helium afterglow was made. (auth)

447 (AD-776663) MICROWAVE MODULATION OF CO_2 LASERS IN GaAs THIN FILM OPTICAL WAVEGUIDES. Semiannual Technical Report No. 3, 25 September 1973-25 March 1974. Cheo, P. K.; Gilden, M.; Fradin, D.; Wagner, R. (United Aircraft Corp., East Hartford, Conn. (USA). Research Labs.). 29 Mar 1974. Contract N00014-73-C-0087. 64p. (UARL-N921513-6). NTIS $3.75.

The long-range objective of this program is to develop an efficient and reliable ultra-wideband thin-film modulator for CO_2 lasers that will be useful for high-resolution, imaging optical radars and high-data-rate optical communication systems. During the present reporting period (September 26, 1973 to Mar 25, 1974), the goal of this program is the demonstration of efficient sideband generation at microwave frequencies (x-band or ku-band) from the 10.6 micrometer CO_2 molecular resonance. For the remaining contractual period (March 26, 1974 to June 25, 1974), the goal is to experimentally demonstrate the generation or frequency-chirped 10.6 micrometer CO_2 laser waveforms using the microwave-driven thin-film modulator developed under the present contract. Characteristics of the frequency chirped optical signals, sideband power limitations and total optical insertion loss of the microwave-driven thin-film modulator will be investigated. In particular, techniques for improving coupling efficiency of both optical and microwave power will be determined. (auth)

448 (AD-776713) OPTIC QUANTUM GENERATORS. Ishchenko, E. F.; Klimkov, Yu. M. (Foreign Technology Div., Wright-Patterson AFB, Ohio (USA)). Feb 1974. Translated from pp 1-470 of Opticheskie Kvantovye Generatory, Moscow, 1968. (FTD-HC-23-486-74). 570p. NTIS $10.75.

The main optical characteristics of radiation, i.e., monochromatism, coherence, directionality, polarization, and power are considered. Problems of the interaction of radiation and the inversion medium and optical cavities are considered and the corresponding terminology is presented. The main types of lasers (gas, solid-state, and semiconductor), the principles of their action, operating principle and main parameters are described. Problems related to practical use of lasers are discussed; methods of measuring the main parameters and characteristics of lasers are described; and methods, formulas and examples of calculation or estimation of the parameters of the device and selection of some of its components are presented. General problems related to most applications of lasers, and also several specific examples are considered. The structure of electron shells, notations of excited states and the system of energy units used in spectroscopy are described in the appendices. (auth)

449 (AD-776805) SMALL-SIGNAL-GAIN AND TIME-RESOLVED SPECTROSCOPY OF THE D_2-F_2/CO_2 PULSED CHEMICAL TRANSFER LASER SYSTEM. Report for March-April 1972. Suchard, S. N. (Aerospace Corp., El Segundo, Calif. (USA)). 15 Mar 1974. Contract F04701-73-C-0074. 15p. (SAMSO-TR-74-56). NTIS $3.00.

Measurements are reported for the small-signal-gain and time-resolved spectral output of a flash-initiated D_2-F_2/CO_2 chemical transfer laser system. Small-signal-gain measurements indicate a possible lack of rotational equilibration among the rotational levels of the CO_2 during the DF-CO_2 V-V energy transfer process. Time-resolved spectral output of this system, operated as a laser oscillator, is presented as verification of the small-signal-gain results. (auth)

450 (AD-777874) CONTROLLED TURBULENCE AS A DESIGN CRITERION FOR ELECTRIC DISCHARGE CONVECTION LASERS. Aunchman, L. J. Jr. (Naval Postgraduate School, Monterey, Calif. (USA)). Mar 1974. 49p. NTIS $5.50.

Thesis.

A preliminary design of a closed-cycle, electric discharge convection laser system is presented. Experimental investigations into the mechanisms of turbulent flow and its stabilization of gaseous, electric discharges were made, spectral distribution, velocity profile, and power consumption data taken in a discharge region are presented. Turbulence was generated by various screens or combination of screens in an attempt to further understand the phenomena involved. (auth)

451 (AD-778027) ATMOSPHERIC PRESSURE GAS LASERS. Semiannual Technical Report, 1 June-30 November 1973. Haus, H. A. (Massachusetts Inst. of Tech., Cambridge (USA)). Apr 1973. Contract DAHC04-72-C-0044. 74p. NTIS $3.75.

The amplification of two high-intensity nanosecond TEA CO_2 laser pulses, mode locking, and a closed-form analysis of electronic distribution and pumping rates are described. (auth)

452 (AD-778032) ELECTRON BEAM PUMPING OF LASER DYES. Final Technical Report, 1 July 1972-31 December 1973. Hodgson, R. T.; Wallace, S. C. (IBM Watson Research Center, Yorktown Heights, N. Y. (USA)). 31 Dec 1973. Contract N00014-73-C-0072. 9p. NTIS $3.00.

The feasibility of electron beam pumped dye lasers was studied. This work was undertaken because such lasers might be capable of producing powerful nanosecond pulses of visible light with a conversion efficiency as high as 5% from electrical energy into light. However, laser action could not be attained. It is proposed that high energy radiation results in indiscriminate ionization and excitation of the supporting solvent for the dye and hence a transient absorption of the fluorescent light. (auth)

453 (AD-778033) INVESTIGATION OF THE FEASIBILITY OF THE ELECTRON BEAM-EXCITED, HIGH-PRESSURE RECOMBINATION LASER. Semiannual Technical Report No. 4, 1 September 1973-28 February 1974. Collins, C. B.; Cunningham, A. J. (Texas Univ., Dallas (USA)). 21 Mar 1974. Contract N00014-67-A-0310-0007. 118p. (UTPD-A-002-4). NTIS $4.50.

Research applied toward the determination of the feasibility of developing a recombining, electron beam-excited plasma into a pulsed laser of exceptionally high peak power is discussed. (auth)

454 (AD-778326) EXCIMER FORMATION AND DECAY PROCESSES IN RARE GASES. Final Report. Lorentz, D. C.; Eckstrom, D. J.; Huestis, D. L. (Stanford Research Inst., Menlo Park, Calif. (USA)). 28 Sep 1973. Contract N00014-72-C-0457. 68p. (SRI-MP-73-2). NTIS $6.50.

A model of the excimer formation and decay processes in electron beam pumped high density rare gases was developed. The model was compared with recent measurements of the excimer formation and decay rates in Xe and information about the radiative lifetimes and dominant collision mechanisms are obtained. Several important conclusions that have bearing on the vuv laser characteristics of these systems are discussed. (auth)

455 (AD-778327) MERCURY VAPOR LASER. Final Technical Report. (Avco-Everett Research Lab., Everett, Mass. (USA)). Jun 1973. 76p. NITS $7.00.

Work on a program to develop a high-power laser utilizing the band emission of high density mercury excited by electrons is described. The spectroscopy and kinetics of excited mercury are discussed. The kinetics of energy exchange between low-energy electrons and mercury is treated in detail, as is the problem of energy deposition for high-voltage electrons penetrating a foil and the mercury gas. The performance of the high voltage, cold cathode electron gun, developed as a laser driver during this contract is described. (auth)

456 (AD-778358) CHEMICAL LASER SYSTEMS. Interim Technical Report, 1 September 1973-28 February 1974. Linevsky, M. J.; Carabetta, R. A. (General Electric Co., Philadelphia, Pa. (USA). Space Div.). 28 Feb 1974. Contract DAAH01-73-C-0653. 36p. NTIS $3.25.

A number of chemical reactions leading to the formation of vibrationally excited HCl were studied spectroscopically employing a diagnostic technique developed during the earlier course of this program. An infrared interferometric technique was employed

to develop a diagnostic procedure which makes possible the spatial (time) measurement of the spontaneous HCl emission as a function of location along the flow axis of the reactor tube. During the course of the studies on the Cl + HI reaction, measurements were made of the atomic iodine (2P1/2) to (2P3/2) emission which has been observed to accompany that from HCl. A number of other HCl producing reactions have also been studied; a spectroscopic examination of the SO + N_2O reaction to produce SO_2 (3B1) has been initiated and some additional work on the CS_2 $(N_2O)O_2$ flame laser has been carried out. Finally, a small effort to investigate means for efficiently producing metal atoms by chemical reaction has been initiated. In these experiments, Cu metal atoms were electrically excited by means of a pulsed electric discharge through CuCl vapor diluted with argon. (auth)

457 (AD-778446) ELECTRICAL DISCHARGE INITIATION OF CHEMICAL REACTANTS IN PULSE HF CHEMICAL LASER SYSTEMS. Final Scientific Report, June 1972–June 1973. Paulson, R. F. (Aerospace Research Labs., Wright-Patterson AFB, Ohio (USA)). Feb 1974. 63p. (ARL-74-0011). NTIS $3.75.

The results of a numerical simulation of the electrical discharge initiation by a pin discharge of an $SF_6 : H_2$ reaction in a pulse HF laser system are given. A parameter variation of the amplitude and the temporal length and shape of the electrical discharge pulse is made. The resulting chemical reactions are simulated by the rate equation method for a reaction in a reaction cell, a laser cavity, and a laser amplifier. The effect of spatial inhomogeneity of the chemical reaction in a laser amplifier is considered. A pin electrical discharge laser system used in the initial experimental studies of the initiation of chemical reactions is described. Typical laser output pulses for the system are shown for $SF_6 : H_2 : He$ reactants. (auth)

458 VIBRATIONAL NONEQUILIBRIUM IN CARBON DIOXIDE ELECTRIC DISCHARGE LASERS. Murray, E. R. Jr. Stanford, CA; Stanford Univ. (1974). 148p. University Microfilms Order No. 74-20,214.

Thesis (Ph. D.).

An experimental and theoretical investigation of the vibrational nonequilibrium in a CO_2-N_2-He electric discharge was performed under strong nonequilibrium conditions. A tuneable, spectrally pure CO_2 laser was constructed and used with a double-beam diagnostic system to measure small signal 10.6 and 9.6 micron gain in an electric discharge laser amplifier tube. Vibrational temperatures of the symmetric and bending modes were determined by combining the gain measurements with a direct measurement of the vibrational temperature of the asymmetric mode using a band reversal. Experimental conditions investigated included total pressures between 5 and 10 torr, and tube current levels between 5 and 20 milliamps. The gas mixture consisted of 10% CO_2, 10% N_2, and 80% He. The Pyrex amplifier tube was 1 centimeter in diameter and had an active length of 100 centimeters. Measurements were also made of the gas temperature using a thermocouple, the electron temperature using miniature Langmuir probes, and electron concentration using electric field probes. (Diss. Abstr. Int., B)

Cryogenic and Superconducting Equipment and Devices

Refer also to abstracts 82, 333, and 1979.

459 (BNL-18762) BNL MATERIALS RESEARCH FOR AN AC SUPERCONDUCTING POWER TRANSMISSION CABLE. Gurinsky, D. H. (Brookhaven National Lab., Upton, N. Y. (USA)). 1 Apr 1974. 36p. (CONF-740448-1). Dep. NTIS $5.00.

From program exchange for Brookhaven and USSR transmission line work meeting; Washington, District of Columbia, USA (8 Apr 1974).

460 (BNL-19133) UNIVERSITY'S ROLE IN RESEARCH ON SUPERCONDUCTING POWER TRANSMISSION. Forsyth, E. B. (Brookhaven National Lab., Upton, N. Y. (USA)). [nd]. 6p. (CONF-740936-1). Dep. NTIS $4.00.

From conference on research in electric transmission and distribution; Buffalo, New York, USA (30 Sep 1974).

Power transmission by superconducting cables appears to have enormous potential for the utility industry. It has still to be demonstrated that it will become a viable and economically competitive technology, however development aimed at this goal by major research establishments has already exposed numerous research problems suitable for investigation by well qualified university departments without requiring large expenditures for equipment. What is missing is an organizational structure to relate work to the primary goals, monitor progress and influence the funding decisions of the major agencies. This does not seem difficult to set up, but continued success will require a long-term commitment from the participants. (auth)

461 (WASH-1305) SUPERCONDUCTING POWER TRANSMISSION EXCHANGE. Report of the United States Team's Visit to the Soviet Union, October 9–October 21, 1973. Belanger, B. C. (ed.). (USAEC Division of Applied Technology, Washington, D. C.). 1973. 49p. Dep. NTIS $4.00.

462 FLUCTUATION PHENOMENA IN TUNNEL JUNCTIONS. Rogovin, D. (Univ. of Arizona, Tucson); Scalapino, D. J. Ann. Phys. (N. Y.); 86: No. 1, 1-90(Jul 1974).

A general theory of electrodynamic fluctuations in tunnel junctions is developed. Using standard many-body techniques the quasiparticle, pair, and quasi-particle–pair current power spectra were determined and these current fluctuations are simply related to the associated pieces of the junction I(V) characteristic. In addition, a theory of the Josephson radiation linewidth is presented. (auth)

463 AMPLIFICATION OF MICROWAVES BY SUPERCONDUCTING MICROBRIDGES IN A FOUR–WAVE PARAMETRIC MODE. Parrish, P.T.; Chiao, R.Y. (Department of Physics, University of California, Berkeley, California 94720). Appl. Phys. Lett. 25: No. 10, 627-629 (15 Nov 1974).

We have observed an electronic gain of 12 dB at 10 GHz in a parametric amplifier whose nonlinear element is a series of unbiased Anderson–Dayem microbridges. The bandwidth was measured to be 1 GHz and the noise temperature to be less than 20 K. (auth)

464 THE APPLICATION OF CRYOPHYSICS AND SUPERCONDUCTION IN POWER TECHNOLOGY. P. 1. Komarek, P. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Experimentelle Kernphysik). Kaelte (Hamburg); 27: No. 1, 6-17 (Jan 1974). (In German).

14 figs.; 48 refs.

A general survey is given on the physical principles, technological problems and technical economical aspects of elements of cryogenic power technology. Superconduction in general and large superconducting magnets in particular, are gone into more deeply. The following are individually dealt with: type I, II and "hard" superconductors, the transition temperature, instabilities (flow jumps), stability criteria for wires (multifilament wires), conductors for alternating field stress (eddy current, hysteresis and self-consistent field losses), winding concepts and cryotechnical construction problems with superconducting magnets. (GE)

Heat Transfer and Fluid Flow

Refer also to abstracts 1290, 2316, 2325, 2340, 2343, 2346, 2376, 2462–2469, 2477, and 2535.

465 (BNL-tr-573) HYDRODYNAMIC BOILING CRISIS. Kutateladze, S. S. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. Translated by S. J. Amoretty of pp 162-168 from Boundary Layer Turbulence, Nauka, Novosibirsk, 1973. 14p. Dep. NTIS $4.00.

Mathematical models were developed to describe the hydrodynamic crisis in pool boiling of saturated and subcooled liquids and in the case of the unrestricted longitudinal flow of a saturated liquid around a plate. (LCL)

466 (CONF-740401-P2, pp 865-880) STUDIES OF HEAT REMOVAL FROM HEAT GENERATING BOILING POOLS. Stein, R. P.; Hesson, J. C.; Gunther, W. H. (Argonne National Lab., Ill.). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

First-of-a-kind experiments were performed in which water was boiled in open rectangular containers by internal heat generation. Small amounts of salt were added to the water so that it would be electrically conducting. Internal heating was obtained by the passage of electrical current through the liquid. For the first series of experiments, the boiling pool was cooled at the bottom surface only. For the second series of experiments, the pool was also cooled at two opposing vertical sides of the container. Downward heat fluxes were found to be significantly larger than values calculated by simple heat conduction from a stagnant lower liquid layer. At the higher boiling rates, horizontal heat fluxes were found to be significantly larger than values calculated by thermal convection alone and could be correlated empirically with boiling rates based on a laminar forced convection model. The experiments led to recommended improvements for the performance of future experiments. (auth)

467 (CONF-740925-4) IMPROVED PREDICTION OF CRITICAL HEAT FLUX IN LIQUID METAL POOL BOILING. Bankoff, S. G.; Fauske, H. K. (Argonne National Lab., Ill. (USA)). 1974. 5p. Dep. NTIS $4.00.

From 5th international heat transfer conference; Tokyo, Japan (3 Sep 1974).

The Kutateladze criterion for the pool boiling critical heat flux, which works well for nonmetallic liquids at or above atmospheric pressure, fails for the alkali liquid metals in the pressure range of interest for Liquid Metal Fast Breeder Reactor applications. In this pressure range bubble growth of the alkali liquid metals is largely inertia-controlled, in view of the large thermal conductivities, which implies a significant condensing heat flux within the bubbles themselves. The bubble growth is assumed to be described by the Mikic, Rohsenow, and Griffith equation. In this way a mean bubble age is determined, and hence a mean bubble thermal boundary layer thickness. The time-average critical heat flux is then obtained as the sum of the Kutateladze flux and the flux due to condensation on the bubble surfaces. No empirical parameters are employed. The present analysis predicts critical heat fluxes lying generally within the data band. (auth)

468 (COO-3027-14) HEAT TRANSFER IN POOL BOILING AND CONDENSING SELENIUM. Breitstein, L.; Bonilla, C. F. (Columbia Univ., New York (USA)). 1974. Contract AT(11-1)-3027. 6p. (CONF-740925-7). Dep. NTIS $4.00.

From 5th international heat transfer conference; Tokyo, Japan (3 Sep 1974).

Heat transfer data for the pool boiling and condensation of elemental selenium were obtained and correlated. The heat transfer surfaces consisted of a horizontal stainless steel 316 boiling plate and condensing tube. Heat transfer coefficients ranged from 681 to 6810 W m^2/°K (120 to 1200 BTU hr · ft^2/°F) in the case of boiling and from 454 to 1305 W m^2/°K (80 to 230 BTU hr · ft^2/°F) in the case of condensation, over a pressure range of 0.133 to 10.1N cm^2 (10 to 760 torr), at 437 to 687°C, respectively. Corrosion of the apparatus, though heavy, was found to have insignificant effect on the heat transfer data. Results were interpreted qualitatively in terms of the complex molecular chain and ring structure of liquid and vapor selenium. (auth)

469 REVIEW OF THE ITALIAN RESEARCH ACTIVITY IN THE FIELD OF THERMOHYDRAULICS OF TWO-PHASE FLUIDS. Termotecnica (Milan), Suppl.; 28: No. 21, 1-130(Jan 1974). (In Italian).

The programs and principal results obtained in Italian research institutions and universities are briefly summarized for each institution. A review presented at a Bologna conference in 1968 on the principal applicative aspects of flowing two-phase fluids in various industrial sectors is included. Recommendations are made for additional research and on the dissemination of the data obtained. (JSR)

470 EXPERIMENTAL STUDY ON HEAT TRANSFER OF DECELERATING FLOW IN AN ANNULUS. Ichimiya, K. (Kyushu Univ., Fukuoka); Hasegawa, S.; Tani, Y.; Kusumoto, S. Nippon Kikai Gakkai Rombunshu; 39: No. 325, 2816-2824(Sep 1973). (In Japanese).

The heat transfer of decelerating flow in an expanding annulus is experimentally clarified with a parameter of an expanding angle. The decelerating flow of air was realized in an annulus, of which the inner tube was heated and the outer tube was enlarged in axial direction. The Reynolds number of heat flux of measured flow was 2.5 to 3.8×10^4 and 850 to 1430 kcal/m^2h, respectively. Based on the surface temperature of the inner tube, the entrance temperature of fluid, air flow rate and electric power input, the local heat transfer coefficient α and local Nusselt number Nu were calculated. As the result, the following points were clarified. The local heat transfer coefficient decreased in the expanding region, but had a maximum value at some point, probably because the viscous layer on the inner tube surface became thinner, thermal resistivity decreased, and wall temperature did not rise. The local heat transfer coefficient was several times as large as the heat transfer coefficient developed at a local region. The ratio of the local Nusselt number Nu and the Nusselt number developed at a local region $N_{u\theta}$ was formulated as the following experimental formula: $N_{u\theta} = 0.022 [8.2 (\tan(\theta/2))^{1.7} (x/d_{he}) + 1] \times Re^{0.77} (d_e/d_i)^{0.12}$ where, $4° \leq \theta \leq 15°22'$, $2.5 \times 10^4 \leq Re \leq 3.8 \times 10^4$. (JA)

471 HIGH SPEED TWO-PHASE FLOW. IV. Two-Phase Discharge Coefficient of Large Sharp-Edged Orifice. Adachi, H. (Japan Atomic Energy Research Inst., Tokai). Nippon Genshiryoku Gakkaishi; 16: No. 6, 322-329(Jun 1974). (In Japanese).

The two-phase discharge coefficient C_D of a large sharp-edged orifice was derived experimentally from the ROSA-I data of the Japan Atomic Energy Research Institute. These orifices are used for predicting the discharge flow rate in the event of a loss-of-coolant accident occurring in a light water nuclear reactor. In this analysis, x_0 the transient value of the quality of the discharged fluid in the high pressure reservoir, is calculated from the reservoir pressure P_0 and the weight w of the residual fluid, using the "depressurization rate method", proposed in the second report of the present series. Furthermore, the standard value of the two-phase critical weight velocity G_C is obtained with use of the author's theory presented in the first report. The relation between C_D and x_0 varies markedly according to the quality. When x_0 is not so small, C_D is determined only by the orifice diameter D, and does not vary with x_0 or P_0. When x_0 approaches zero, C_D increases sharply, reaching a value of 1.5. At the same time it increases slightly with decreasing P_0 and with decreasing D. The physical meaning of this behavior of C_D is considered as follows. When x_0 is not very small, flow contraction occurs immediately downstream of the orifice, and at the same time there takes place the severe supercooling of the steam phase. The value of C_D diminishes below unity, for these two reasons, the latter being probably more important. On the other hand, when x_0 is close to zero, the rapid depressurization of the fluid causes a shortage of bubble nuclei, which prevents vaporization from proceeding at the rate dictated by the depressurization, and this raises C_D above unity. (auth)

Materials Testing

Refer also to abstract 646.

472 (AD-780348) INVESTIGATION INTO THE EFFECTS OF SCATTERED RADIATION UPON IMAGE SHARPNESS AND CONTRAST USING COBALT-60 GAMMA RADIATION AND STEEL PLATES IN THE THICKNESS RANGE 20 TO 100 mm. Dowd, M.; Halmshaw, R. (Royal Armament Research and Development Establishment, Fort Halstead (UK)). Mar 1974. 16p. (RARDE-MEMO-1/74). NTIS $3.00.

The effect of scattered radiation generated in the specimen, on the image of detail on a radiograph, was studied, using cobalt-60 gamma-rays and steel plates. It was found, contrary to some other published work, that there is no effect on image sharpness, due to the scattered radiation. (auth)

473 (ARL/Met.-2) BIBLIOGRAPHY ON STRESS WAVE EMISSION, 1950-1973. Martin, G. G. (Aeronautical Research Labs., Melbourne (Australia)). Feb 1974. 74p. Dep. NTIS (US Sales Only) $6.75.

More than 400 known sources of information relating to stress wave emission have been collected and listed under two headings—articles readily available in Australia and those available elsewhere; descriptors have been provided for the former. (auth)

474 PERFORMANCE CHARACTERISTICS OF RADIOGRAPHIC SYSTEMS: FILM AND SOLUTION. Lomerson, E. O. Jr.; Tousignant, D. N. (Pratt and Whitney Aircraft Division, East Hartford, CT). Mater. Eval.; 32: No. 10, 213-217(Oct 1974).

A study was conducted to gain additional knowledge of the performance characteristics of a number of x-ray film and processing solution systems. Specific properties evaluated include speed, contrast, visual incompatibilities, base and fog density, visibility of pentrameter images and levels of residual chemicals as related to various films, processing solutions, and kilovoltages. Aspects of system interchangeability and classification are also discussed. (auth)

475 AUTOMATIC TESTING SYSTEMS DEVELOPMENT BROUGHT ABOUT BY NUCLEAR CONSTRUCTION. Destribats, T.; Prot, A.; Saglic, R.; Thome, P. (CEN de Saclay, Gif-sur-Yvette, France). Rev. Met. (Paris); No. Special Edition, 25-38([nd]). (In French).

From meeting on the automatic systems in nondestructive testing; Paris, France (12 Jan 1971).

With the development of automatic testing systems, efforts have been concentrated along two complementary directions. The first one concerns the mechanical aspect of the presentation of parts in relation to the fixed testing organ, or conversely the systematic testing of a part by means of sensors sweeping across it. The second direction concerns the recording systems and the methods enabling the information to be presented to these recording devices. Examples are given on cladding and fuel element testing processes and on the system for testing the welds of heat exchangers and reactor vessels. (FR)

476 AUTOMATIC NONDESTRUCTIVE TESTING INCORPORATED IN AN ATOMIC FUEL PRODUCTION LINE. Destribats, T. (CEN de Saclay, Gif-sur-Yvette, France); Beauchene, G.; Picard, P.; Savornin, B. Rev. Met. (Paris); No. Special Edition, 25-38([nd]). (In French).

From meeting on the automatic systems in nondestructive testing; Paris, France (12 Jan 1971).

The high performance and operational safety demanded by the Bugey I fuel element require nondestructive testing in the industrial production stage. This made it necessary to provide

control stations in the production line. A description is given of five such installations using ultrasonics (testing the grain size of the uranium tube, measuring the thickness of the uranium tubes, assessing the depth of the grooves in the uranium tube, testing the weld depth of the plugs and testing the diffusion between cladding and uranium. (FR)

477 AUTOMATIC GAMMAGRAPHIC TESTING APPLIED TO OIL AND GAS PIPE LINE ASSEMBLIES. Francois, G. (Institut de Soudure, Paris). Rev. Met. (Paris); No. Special Edition, 39-45([nd]). (In French).

From meeting on the automatic systems in nondestructive testing; Paris, France (12 Jan 1971).

For a long time gammagraphy has been used to test the circular welds joining together oil and gas pipeline sections. At first, this testing was effected in a very simple manner by placing the radiation source and the film diametrically opposite each other on the outside of the pipe. As the pipes became larger in diameter this method proved to be too slow and unable to keep up with the daily pipe laying rates. Work with the radiation source inside the pipe was considered to be the only logical and desirable solution. A brief study is made of the change in the various types of equipment used which made it possible to reach gammagraphic testing with automatic machines moving in the pipes. (FR)

478 RADIOGRAPHIC AND ULTRASONIC TESTING OF WELDED JOINTS: COMPARATIVE ECONOMICS EVALUATION. Hess, H. Praktiker; 25: No. 6, 116-118(1973). (In German). 1 tab.

From the economic point of view, the ultrasonic testing method has advantages compared with radiographic methods, but cannot be applied in all cases. The radiographic method is advantageous because its film image produces a document of the welding joint quality. (GE)

479 ACOUSTIC EMISSION COINCIDENCE DETECTOR FOR MONITORING HIGH RESIDUAL STRESS AREAS IN SYMMETRICAL PRESSURE VESSELS. Sewall, N. R. (Univ. of California, Livermore). pp 247-250 of Proceedings of the Nineteenth International ISA Aerospace Instrumentation Symposium. Washburn, B. (ed.). Pittsburgh; Instrument Society of America (1973).

From 19th international aerospace instrumentation symposium; Las Vegas, Nevada, USA (21 May 1973). See CONF-730510-.

In pressure vessels where high residual stress areas are suspected, acoustic emission can be a valuable nondestructive testing tool in the process of proofing the vessel. Naturally, the suspected areas of failure would be in the inlet-tube connection weld or braze, or a waist weld in the part itself. Welding destroys the homogeneity of the base metal itself; hence, you can suspect high residual stresses left in the base metal after welding has taken place. In proof testing, by judicious placement of acoustic emission transducers along with the described flaw detection coincidence circuitry, a vessel can be checked or somewhat certified against high residual stress areas causing microcracks, by the acoustic emission addition to the proof test. The problem and the proposed solution including the acoustic flaw window, acoustic velocity in the material, reflection or reradiation of bursts, the placement of transducers, and the final circuit are discussed. The results have been very helpful in the certification of the vessels tested. (auth)

480 PROBLEMS AND DISCUSSIONS ON RADIOGRAPHIC TESTS OF WELDED CIRCUMFERENTIAL BUTT JOINTS IN ALUMINUM PIPES. Arrangement of Measuring Apparatuses in Single or Double Walls Radiographic Photographing Methods. Ooka, N. (Japan Atomic Energy Research Inst., Oarai, Japan). Keikinzoku Yosetsu; No. 131, 457-464(Nov 1973). (In Japanese).

To establish and standardize radiographic testing methods for welded circumferential butt joints in light metals, especially aluminium pipes, the effective arrangement of the radiation source, penetrometers, film, and the densitometer in single or double wall photographing methods was examined referring to the BS, ASME, and EBASCO specifications. Since these methods are used in field tests, mounting the penetrometer and the densitometer at the film side of the pipe is permitted if a few corrections are made when they cannot be mounted at the source side of the pipe. If irradiation is needed from an oblique direction, it is better to shift the x-ray tube toward the cathode side. Though the moving distance of the x-ray tube focus is theoretically calculated from the equations, it is desirable to determine the value of required image movement by a diagram which plots the x-ray tube focus shift amount and irradiation angle vs. the ratio of distance of the radiation source from the film/diameter of tube. (JA)

481 NDT TECHNIQUE FOR PRESSURE VESSELS, BASED ON STRESS WAVE EMISSION ANALYSIS DURING HYDROTEST. Fontana, E.; Grugni, G.; Pirovano, B.; Possa, G.; Tonolini, F. (CISE, Milan). Energ. Nucl. (Milan); 21: No. 10, 550-559(Oct 1974). (In Italian).

A relatively new NDT technique for pressure vessels, based on stress wave emission detection and analysis during hydrotest, is presented. The instrumentation commonly used for detection and signal conditioning is briefly outlined. Methods for acoustic source location are reported. The status of art of this fast progressing inspection technique is surveyed. (auth)

482 DENSITOMETRIC MEASUREMENT OF THE THICKNESS OF FAULTS DETECTED BY GAMMA-RADIOGRAPHY. Beaubron, A.; Manaranche, J. C. pp vp of Seventh International Conference on Nondestructive Testing. Vol. III. Warsaw; Polish Society of Mechanical Engineers (1973). (In French)

From 7th international conference on nondestructive testing; Warsaw, Poland (4 Jun 1973).

A method for measuring quantitatively the thickness of defects revealed by gamma-radiograms is proposed. The theory of the method is based on a quantitative relationship between the variation in optical density observed along the track of the defects and the thickness of the defect. This density modification is associated with the difference in local radiation absorption. The method is verified experimentally, using plates prepared from various metals, containing 5-mm-diam cylindrical holes. The method proposed is readily extendable to radiograms by x rays. (IAA)

483 MICROCHANNEL IMAGE INTENSIFIER FOR NEUTRON RADIOGRAPHY. Chalmeton, V. (Laboratoires d'Electronique et de Physique Appliquee, Val-de-Marne, France). pp vp of Seventh International Conference on Nondestructive Testing. Vol. III. Warsaw; Polish Society of Mechanical Engineers (1973).

From 7th international conference on nondestructive testing; Warsaw, Poland (4 Jun 1973).

An arrangement for reducing the exposure times required for taking neutron radiographic pictures by reducing the integrated neutron flux necessary for such pictures is described. The proposed image intensifier arrangement involves the use of a microchannel plate in association with a thin gadolinium converting layer operating in the transmission mode and located close to the input of the microchannel plate to obtain a picture of the neutron flux density on a fluorescent output screen. (IAA)

484 FAST NEUTRON DEFECTOSCOPY DEVELOPMENT. Gorbunov, V. I.; Pekarskii, G. Sh. (SRIEI, Tomsk). pp vp of Seventh International Conference on Nondestructive Testing. Vol. III. Warsaw; Polish Society of Mechanical Engineers (1973).

From 7th international conference on nondestructive testing; Warsaw, Poland (4 Jun 1973).

Evaluation of the utility of fast neutron defectoscopy in comparison with gamma-ray and betatron defectoscopy in quality control of products. It is found that when measuring thicknesses and searching for flaws in heavy metal products with large thicknesses the use of fast neutrons makes it possible to increase the control productivity and to increase the controlled thickness range in comparison with gamma-ray and betatron defectoscopes. The most useful application of fast neutrons in defectoscopy is the control of multilayer products with a high selective sensitivity to a light material layer behind one or more heavy material layers. Also, the use of fast neutrons for product control opens new possibilities when a product is inspected from one side. (IAA)

485 OPTIMIZATION OF DETECTOR PARAMETERS IN NEUTRON RADIOGRAPHY. Tiufiakov, N. D.; Shtan, A. S.; Iaskevich, V. S. (VNIIRT, Moscow). pp vp of Seventh International Conference on Nondestructive Testing. Vol. III. Warsaw; Polish Society of Mechanical Engineers (1973).

From 7th international conference on nondestructive testing; Warsaw, Poland (4 Jun 1973).

Consideration of the effect of the parameters of the converter screens used in a neutron radiography detector on the quality of neutron images obtained on an x-ray film using direct-exposure and transfer methods is presented. In particular, a study is made of the effect of secondary radiation generated in the screens as a result of neutron bombardment on image unsharpness, and of the role of the thickness of the front and back screens in determining the secondary radiation flux distribution. The results of experimental determinations of image unsharpness are presented for screens made of different materials using x-ray film exposed by the transfer method. (IAA)

486 NONDESTRUCTIVE TESTING SYMBOLS. AWS A2.2-69. Miami, FL; American Welding Society, Inc. (1969). 11p. (ICONS-01824).

This standard establishes the symbols for use on drawings to specify nondestructive tests for determining the soundness of materials. (auth)

Nuclear Explosions

Refer also to abstracts 528, 537, 646, and 833–835.

487 (AD-778956) COUNTEREVASION STUDIES. Semiannual Technical Report No. 1 (Part B), 1 May–31 October 1973. Lane, S. S. (Texas Instruments, Inc., Dallas (USA)). 15 Nov 1973. Contract F44620-73-C-0055. 46p. (AFOSR-TR-74-0745). NTIS $3.25.

Results to date on a study to determine the effectiveness of two methods which may be used to separate interfering seismic events are summarized. These techniques have potential value for counterevasion studies, in that they are expected to distinguish underground nuclear explosions hidden in larger earthquakes, and to identify sequential underground nuclear explosions disguised as earthquakes. The techniques are applied to markedly different combinations of interfering waveforms. The complex spectrum technique separates signals from the same azimuth, whose waveforms and thus spectra are similar. It does so by treating the entire spectrum of the data. The eigenspectrum technique, by contrast, is used to separate signals from different azimuths, with greatly different spectra, and considers the data over a narrow frequency band. (GRA)

488 (AD–778996) DETERMINATION OF SEISMIC SOURCE PARAMETERS FROM FREQUENCY DEPENDENT RAYLEIGH AND LOVE WAVE RADIATION PATTERNS. Semiannual Technical Report No. 1, Pt. C, 1 May–31 October 1973. Turnbull, L. S. Jr.; Sun, D. F. D.; Shaub, J. S. (Texas Instruments, Inc., Dallas (USA)). 15 Nov 1973. Contract F44620-73-C-0055. 192p. (AFOSR-TR–74-0782). NTIS $5.50.

Both exhaustive and non-linear spectral fitting procedures are applied to far-field surface wave data for determining seismic source parameters, especially depth. These procedures were applied to a series of events with decreasing control on the source parameters. High quality Rayleigh wave data from the southeastern Missouri earthquake of October 21, 1965 were analyzed, and the parameter corroboration with independent estimates was good, with excellent spectral fits. Two low magnitude (mb = 4.1) Italian events were analyzed individually and by taking spectral ratios. Six events from Sinkiang were analyzed, again using both techniques. Initial efforts are directed towards determining the importance of the parameter variations; it was found that depth has the greatest effect on the shape of the spectra. (auth)

489 (AD-779919) DIHEST IMPROVEMENT PROGRAM TEST DIP IIIA. Final report, 1 January 1972 – 30 August 1973 Schlater, D. R. (Air Force Weapons Lab., Kirtland AFB, N. Mex (USA)). Apr 1974. 213p. (AFWL-TR-74-16). NTIS $5.75.

Ground motion data are presented from Project DIP IIIA. The third experiment in the Dihest Improvement Program (DIP) series. The experiment, fired May 20, 1972 near Albuquerque, New Mexico, was designed to measure velocity, acceleration, displacement, soil stress, and blast pressure from the detonation of a 6600-lb buried, decoupled direct-induced high-explosive simulation technique (Dihest) array of slurry explosive. Rear boundary relief was provided on the east side of the array in the form of a long deep trench situated 100 ft away and parallel to the explosive array. On the west side of the array the boundary relief consisted of two rows of deep 4-ft diameter holes. The free-field ground motion instruments were installed 5 to 60 ft deep in 12-in. dia holes in a rectilinear array at distances of 16 to 90 ft from the plane of the explosive array. Plots of the electronic data traces are presented. The response of four buried cylindrical research structures to the explosion is also reported. (auth)

490 (AWRE-O-7/74) PEACEFUL USES OF NUCLEAR EXPLOSIVES. Review Paper No. 6. Containment of Nuclear Explosions. Yeo, E. H. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment). Sep 1974. 26p. Dep. NTIS (U. S. Sales Only) $4.50. UK 50 pence.

The problems involved in ensuring the containment of peaceful underground nuclear explosions are reviewed, and the factors which need to be considered by those responsible for any particular project using contained nuclear explosions are pointed out. (LCL)

491 (COM–74-50462) SEISMIC DATA FOR RIO BLANCO. Hunter, R. (National Oceanic and Atmospheric Administration, Boulder, Colo. (USA)). May 1973. 25p. (NOAA-TR-ERL–294; ESI–32). GPO $0.60.

Nuclear devices set off at Rio Blanco were used as a seismic experiment. Seismic data and epicentral computations are presented. Project Rio Blanco, a cooperative government-industry Plowshare Project, was detonated on May 17, 1973. Three nuclear devices were set off simultaneously at depths of 1780 M, 1899 M, and 2039 M. Each device had a nominal yield of 30 kilotons. The purpose of the experiment was to increase gas production by explosive fracturing of the tight formations and to test the use of multiple devices instead of a single device. In addition to the resulting seismic data, epicentral computations are tabulated. Graphics included are: a physiographic province map, a WNNSS station location map, CNN station location map, short-period response curves, long period response curves, travel-time residuals versus distance, P-wave amplitudes versus distance, surface wave periods and amplitudes versus distance, body wave magnitude versus distance, and surface wave magnetudes versus distance. (auth)

492 (JAB-99-110) DYNAMIC RESPONSE RECONCILIATION OF RESIDENTIAL STRUCTURES: PROJECT TRINIDAD. Reed, J. W. (Blume (John A.) and Associates, Engineers, San Francisco, Calif. (USA)). Oct 1974. Contract AT(26-1)-99. 55p. Dep. NTIS $5.45.

The ground motion and building data for the response of two ground stations and four residential structures to three chemical explosive cratering experiments are presented. The ground motion data are used to predict the peak relative structure motions, which are compared with the recorded structure values. A statistical analysis of the predicted and recorded structure motions indicates reasonable agreement. For the "best estimate" structure dynamic properties (i.e., periods and damping ratios) the mean ratio of predicted to measured peak relative (between ceiling and floor levels) structure velocities is close to 1.0, with a corresponding 95% confidence interval of 0.5 to 1.2. The associated geometric standard deviation of an assumed lognormal distribution is 2.0. The predicted-mean ratio of 1.0 substantiates the practice of predicting structure motions using response spectra. The geometric standard deviation of 2.0 is consistent with values (2.0 to 3.0) reported for general station predicted spectra associated with underground nuclear detonations. (auth)

493 (NVO-134) SIGNIFICANT PEACEFUL NUCLEAR EXPLOSION EVENTS AND RELATED ACTIVITIES. (USAEC Nevada Operations Office, Las Vegas). Jun 1973. 9p. Dep. NTIS $4.00.

Twenty-seven peaceful nuclear explosions are briefly described. Pertinent data such as yield, location, and purpose are presented. (TFD)

494 (PNE-WW-38) STRUCTURAL RESPONSE AND ENVIRONMENTAL IMPACT EVALUATION: SUPPLEMENTAL INVESTIGATION. Phase 1. Project Wagon Wheel. (Dames and Moore, San Francisco, Calif. (USA)). 14 Jun 1974. 219p. Dep. NTIS $14.00.

For El Paso Natural Gas Co., TX.

The seismic effects of Project Wagon Wheel detonations in Wyoming on irrigation systems, river bluff erosion, major hydraulic structures, potential rock fall, and miscellaneous structures such as culverts, irrigation water control structures, and dams were studied. No major damage from the ground motions is predicted. (LCL)

495 (STI/PUB–367) PEACEFUL NUCLEAR EXPLOSIONS III. Applications, Characteristics, and Effects. Panel Proceedings Series. Proceedings of a Panel Held in Vienna, Austria, November 27–December 1, 1972. (International Atomic Energy Agency, Vienna (Austria)). Jun 1974. 495p. (In Several Languages). (CONF-721143–). IAEA $24.00.

Twenty-eight papers were presented at the conference. A separate abstract was prepared for each of 17 papers. Eleven papers appeared previously in NSA as abstracts 28:15449 through 28:15458, and 30:3118. (LCL)

For abstracts of individual papers see: 497–513.

496 (UCID-15963) CALCULATION OF PRESSURE CHANGE AT DEPTH IN A NUCLEAR CHIMNEY FOLLOWING ATMOSPHERIC PRESSURE CHANGE. Morris, G.; Snoeberger, D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Dec 1971. Contract W-7405-eng-48. 8p. Dep. NTIS $4.00.

The permeability of the chimney region formed during collapse to the surface after a nuclear detonation is of interest in the calculation of gas movement in that region. Preliminary calculations show that it might be possible to estimate chimney region permeabilities by monitoring the pressure changes, at known locations in the chimney, that are caused by atmospheric pressure changes associated with the passage of storm fronts. (auth)

497 STATEMENTS ON NATIONAL PROBLEMS: ARAB REPUBLIC OF EGYPT. El Guebeily, M. A.; El Shazly, E. M. (Atomic Energy Establishment, Cairo). pp 3-11 of Peaceful Nuclear Explosions III. Applications, Characteristics, and Effects. Vienna; International Atomic Energy Agency (1974).

From panel on peaceful nuclear explosions, III: Applications, characteristics and effects; Vienna, Austria (27 Nov 1972). See STI/PUB-367; CONF-721143-.

The prospects of peaceful application of nuclear explosions in Egypt with the aim of developing its natural energy resources are

discussed. There is an urgent need to develop the country's industry and agriculture and this, together with fast growing population, makes it imperative to find ways of improving the status of the national energy resources. The first three projects discussed deal with the storage of natural gas, and the stimulation of oil and gas production from their fields, and are directly related to increasing the production and utilization of already-known oil and gas resources by applying contained nuclear explosions. The choice of these projects is governed by local factors connected with their sites, and is guided by the results of the USA and USSR experiments, which have indicated that gas storage and hydrocarbon stimulation might be applied economically in the near future. The fourth project, the tapping of geothermal energy, is suggested here in the light of the tremendous resources of thermal energy in the earth's crust. It has been estimated that the thermal energy stored in the part of the earth's crust accessible by drilling may exceed all the fossil and fissionable nuclear energy reserves by an order of magnitude. Due to the depth of the loci of such sources and the huge energy of any explosion required, nuclear explosions may be called upon to play a special role in tapping these non-polluting energy resources. (auth)

498 STATEMENTS ON NATIONAL PROBLEMS: UNITED STATES OF AMERICA. Johnson, G. W. (Atomic Energy Commission, Washington, DC). pp 15-19 of Peaceful Nuclear Explosions III. Applications, Characteristics, and Effects. Vienna; International Atomic Energy Agency (1974).

From panel on peaceful nuclear explosions, III: Applications, characteristics and effects; Vienna, Austria (27 Nov 1972). See STI/PUB-367; CONF-721143-.

The status of the US Plowshare Program is discussed, primarily its current emphasis, which is to develop natural gas stimulation technology sufficiently for it to be used as needed in commercial gas field development. However, in addition to developing nuclear gas stimulation technology to the stage at which it can be used commercially, the USA is in the process of broadening its Plowshare Program to evaluate the use of nuclear explosions for the recovery of oil from oil shale, for the recovery of copper from copper bearing ore bodies and for in situ coal gasification. Thus, the program is primarily oriented towards developing the necessary technology to tap new or underdeveloped energy resources. In addition, those non-energy natural resources (such as low-grade copper ore) that appear particularly amenable to this technology are also being evaluated. (LCL)

499 STATEMENTS ON NATIONAL PROBLEMS: VENEZUELA. Rodriguez Diaz, A. J. (Instituto Nacional de Canalizaciones, Caracas). pp 21-24 of Peaceful Nuclear Explosions III. Applications, Characteristics, and Effects. Vienna; International Atomic Energy Agency (1974). (In Spanish).

From panel on peaceful nuclear explosions, III: Applications, characteristics and effects; Vienna, Austria (27 Nov 1972). See STI/PUB-367; Vienna, Austria (27 Nov 1972). See STI/PUB-367; CONF-721143-.

Studies initiated in Venezuela to determine possible applications of nuclear explosions in that country are briefly reviewed. These include recovery of geothermal heat, fabrication of subterranean storage sites for industrial wastes or petroleum products, and recovery of petroleum from bituminous areas. The most extensive studies were made on the building of a navigation canal to connect the Orinoco River of Venezuela with the Amazon River of Brazil, and the construction of a navigation canal through Brazil to increase the ease of marine communication with southern South America. (JSR)

500 EXPLOSIVE EXCAVATION FOR WATER ENVIRONMENT AND ROAD CUT APPLICATIONS. LaFrenz, R. L. (Army Corps of Engineers, Livermore, CA). pp 27-53 of Peaceful Nuclear Explosions III. Applications, Characteristics, and Effects. Vienna; International Atomic Energy Agency (1974).

From panel on peaceful nuclear explosions, III: Applications, characteristics and effects; Vienna, Austria (27 Nov 1972). See STI/PUB-367; CONF-721143-.

Since 1962, the US Army Corps of Engineers has been working with the USAEC on a joint program to develop nuclear explosive excavation technology. Until recently the Corps of Engineers' portion of this program was the chemical explosive modelling of planned nuclear excavation tests, participation in the nuclear cratering experiments and development of project designs and engineering and construction data. It became obvious during the conduct of this program that chemical explosive excavation with large charges has many advantages and that the development of chemical explosive excavation as an accepted cost competitive construction technique will facilitate the acceptance of nuclear explosive excavation for larger projects. Therefore, the emphasis of the Corps' program for the past three years has been on the use of chemical explosive excavation for civil engineering applications. The technique has been demonstrated on a water conveyance channel in clay shale, a harbour in coral overlain with water, three railroad cuts in a sandstone and shale medium, breaching of a sandbar, and a side-hill road cut excavation. The railroad cuts were the first projects to show cost effectiveness when the conventional excavation costs were computed for equivalent work. It is expected, however, that the best cost effectiveness will be realized in applying the technique to excavation applications in a water environment. A model testing facility has been used to investigate the effect of a saturated medium and a water over-burden on crater shape and mound velocities. In this facility, crater shape and dimensions were shown to be very sensitive to water overburden depth in sand and rather insensitive with a high strength material. A failure mechanism drastically affecting crater shape was observed on the harbour project in a coral material. Future research will investigate cratering under water in a hard rock medium. (auth)

501 FEASIBILITY OF IN SITU RETORTING OF GREEN RIVER OIL SHALE, UTILIZING NUCLEAR EXPLOSIVES FOR FRACTURING. Sohns, H. W. (Bureau of Mines, Laramie, WY). pp 99-121 of Peaceful Nuclear Explosions III. Applications, Characteristics, and Effects. Vienna; International Atomic Energy Agency (1974).

From panel on peaceful nuclear explosions, III: Applications, characteristics, and effects; Vienna, Austria (27 Nov 1972). See STI/PUB-367; CONF-721143-.

In situ retorting of oil shale, if technologically feasible and economically practicable, has several advantages over the more conventional mining and above-ground retorting system, particularly for deep, thick deposits under appreciable overburden. The problem of disposing of spent shale can be eliminated, air and water pollution problems can be minimized, aesthetic values can be enhanced, it may be possible to produce a higher grade oil, and it may be possible to effect a higher percentage recovery. Although hydraulic fracturing and chemical high explosives may be used to fracture shallow and thin beds, nuclear explosives may be required for adequate fracturing of the Green River oil shale in the center of the Piceance Basin of Colorado, where there are deposits as thick as 2000 ft (610 m) under as much as 1000 ft (305 m) of overburden. Experiments have been conducted at the Bureau of Mines Laramie Energy Research Center in batch-type retorts accommodating particle-size ranges expected to be present in a nuclear-explosive created chimney. Capacities are 10 and 150 metric tons, accommodating pieces of shale as large in two dimensions as 20 in (51 cm) and 4 ft (1.2 m), respectively. In seven tests with the large retort, recoveries were 39% to 62% of Fischer assay, with shale charges assaying 8.0 to 10.1 wt % of oil. In tests of lean shale (5.75 wt %) in the small retort, the highest yield was 51% of Fischer assay. Field tests have been conducted, and still are in progress near Rock Springs, Wyoming, in sections of oil shale ranging from 20 ft (6.1 m) to 40 ft (12.2 m) in thickness and from 68 ft (20.7 m) to 145 ft (44.2 m) in depth. Results of these tests have been somewhat encouraging and indicate that the creation of adequate permeability through carefully designed and controlled fracturing techniques is a critical factor. (auth)

502 GAS QUALITY AND GEOCHEMICAL STUDIES IN GAS STIMULATION EXPERIMENTS. Taylor, R. W. (Univ. of California, Livermore). pp 123-141 of Peaceful Nuclear Explosions III. Applications, Characteristics, and Effects. Vienna; International Atomic Energy Agency (1974).

From panel on peaceful nuclear explosions, III: Applications, characteristics and effects; Vienna, Austria (27 Nov 1972). See STI/PUB-367; CONF-721143-.

Gas produced following the Gasbuggy and Rulison gas-stimulation applications had a different composition to the natural gas produced in the same areas before nuclear stimulation. The principal difference was the presence of CO_2, CO, H_2 and H_2O in the post-explosion gas. There also were changes in ratios of hydrocarbons. Because CO_2 reduces the heating value of the gas and steam presents a troublesome disposal problem due to the trace of tritium it carries, it is necessary to understand these geochemical effects of nuclear explosions. Samples of gas-bearing shales were heated under a variety of conditions and it was found that CO_2 is evolved at temperatures as low as 500°C, even under a CO_2 pressure of 50 atm, due to reactions between the fine-grained carbonates and silicates. In other experimental studies it was found that regions of high temperature (~400°C), rather than radiation, caused the changes in gas composition observed in the Gasbuggy chimney during the six-month "shut-in" period. In looking ahead to the geochemical effects of multiple explosions, it is concluded that less CO_2 will be produced per unit yield than for a single explosion in the same rock. This is because the intensely heated rock is cooled rapidly by the convecting gas before it can heat adjacent rubble, which results in less rubble being heated hot enough to release CO_2. Steam production, however, will be greater in the case of multiple explosions than for single explosions be-

cause a higher fraction of the total yield is deposited as heat in the chimney, thus increasing average chimney temperature. The average chimney temperature, and thus the steam pressure, increases as the distance between multiple explosions is decreased. The steam pressure will also increase as the depth of nuclear explosions is increased. (auth)

503 UNDERGROUND NUCLEAR EXPLOSION AS A PRELUDE TO THE CHEMICAL MINING OF PRIMARY COPPER SULFIDES. Lewis, A. E.; Braun, R. L.; Higgins, G. H. (Univ. of California, Livermore). pp 157-175 of Peaceful Nuclear Explosions III. Applications, Characteristics, and Effects. Vienna; International Atomic Energy Agency (1974).

From panel on peaceful nuclear explosions, III: Applications, characteristics and effects; Vienna, Austria (27 Nov 1972). See STI/PUB-367; CONF-721143-.

A contained nuclear explosion to produce a chimney of broken ore well below the water table is proposed. After the chimney is filled with water and reaches hydrostatic equilibrium, oxygen is introduced near the bottom of the mass of broken rock. The increase in solubility of oxygen at high hydrostatic pressure is sufficient to initiate the oxidation of the primary sulfides—chalcopyrite and pyrite. The oxidation and dissolution of these sulfides produce enough heat to increase the temperature of the ore and water in the chimney as much as 100°C. The rate of dissolution of chalcopyrite is so rapid under these conditions that the rate of copper extraction becomes principally limited by the physical accessibility of the chalcopyrite within the ore fragments. Data are presented from laboratory and pilot-plant studies conducted during the past two years on the rate of extraction of copper from the primary sulfide ore. Results from these studies are used in developing a computer model for estimating the rate of recovery and ultimate economic recovery of copper values in large-scale solution mining. Economic analysis shows that nuclear solution mining is very competitive with other mining techniques. The method is broadly applicable to the low-grade, deep deposits which are needed for future production. Problems of ground shock and radioactivity are manageable, and many environmental problems associated with conventional mining are eliminated. (auth)

504 CRATERS AS ENGINEERING STRUCTURES. Day, W. C. (Army Engineer Waterways Experiment Station, Livermore, CA). pp 193-233 of Peaceful Nuclear Explosions III. Applications, Characteristics, and Effects. Vienna; International Atomic Energy Agency (1974).

From panel on peaceful nuclear explosions, III: Applications, characteristics and effects; Vienna, Austria (27 Nov 1972). See STI/PUB-367; CONF-721143-.

The results of studies and field investigations of the zones and physical properties of explosively produced craters are summarized. Field investigations of the six United States nuclear craters, Danny Boy, Sedan, Sulky, Cabriolet, Buggy and Schooner, and many chemical explosive craters have been carried out. These investigations were conducted to determine such properties as the: geometry of the apparent crater, true crater and rupture zone; gradation or size distribution of the broken material in the rubble zone; bulk density, bulking factor and porosity of the rubble and rupture zones; degree and orientation of blast fracturing and permanent displacements in the rupture zone; mass strength of rubble and rupture zone materials; and compressibility of rubble and rupture zone materials (settlement). Data gathered in these field investigations have been used in studies and laboratory research dealing with the evaluation of explosively produced craters as engineering structures. The most important questions in an engineering analysis of craters deal with the stability of the crater slopes, water seepage and groundwater conditions, and settlement of rubble zone materials. These have direct bearing on the suitability of craters as canals and water conveyance channels, harbours, reservoirs, road cuts and other engineering structures. Slope stability analyses have received by far the most attention because of the necessity to asses the stability of large crater slopes considered in the proposed design of a nuclear inter-oceanic sea-level canal. All conditions relating to possible failure of crater slopes have been studied, including material properties, geologic structure, seepage and groundwater conditions, and seismic loading. It was found that, with good permeability data, hydraulic conditions can be accurately modelled by the finite element technique. The method allows of direct determination of seepage rates, seepage pressures, and the position of the free water surface for steady-state flow conditions. Parameter studies with several permeability conditions were investigated. Testing for mechanical properties of fall-back material was first tried on the sandstone and shale material from an explosively excavated railroad cut. Laboratory test data include particle gradation, strength and compressibility characteristics. Compaction tests were conducted in the field under both dry and wet conditions. The general assessment is that an explosively produced crater is initially stable and that, unless some adverse condition develops because of changes in material properties or hydraulic conditions with time, it will remain stable. The basic problem then is to be able to predict changes and assess the consequences of these changes. (auth)

505 EXPERIMENTAL AND THEORETICAL STUDIES OF CRATER DIMENSIONS PRODUCED BY CHEMICAL EXPLOSIONS IN SOILS. Gautier, J.; Perroud, P. (CEN, Grenoble, France). pp 235-250 of Peaceful Nuclear Explosions III. Applications, Characteristics, and Effects. Vienna; International Atomic Energy Agency (1974). (In French).

From panel on peaceful nuclear explosions, III: Applications, characteristics and effects; Vienna, Austria (27 Nov 1972). See STI/PUB-367; CONF-721143-.

The results presented concern the dimensions of explosion-produced craters in soils and rocks, and were obtained as a part of the Dynasol program in 1968-70. The experimental studies included medium charge shots of high explosives (1 to 250 kg) in silt and clay, and gram-size shots (5 to 15 g) in sand. Nomograms, obtained from an integrated study, enable calculations of crater dimensions in relation to the properties of chemical explosives and the mechanical characteristics of soils and rocks to be made. (auth)

506 CALCULATION OF ROCK FRACTURING FROM MULTIPLE NUCLEAR EXPLOSIVE SOURCES. Terhune, R. W.; Shaw, J. G. (Univ. of California, Livermore). pp 251-275 of Peaceful Nuclear Explosions III. Applications, Characteristics, and Effects. Vienna; International Atomic Energy Agency (1974).

From panel on peaceful nuclear explosions, III: applications, characteristics and effects; Vienna, Austria (27 Nov 1972). See STI/PUB-367; CONF-721143-.

SOC calculations that agree with experimental measurements of the cavity radii, fracture initiation, and maximum extent of fracturing for the Gasbuggy and Rulison experiments are presented. Most importantly, a criterion is established that relates the number of times a zone in the calculations is fractured, with those regions around the detonation where extensive fracturing is observed experimentally. The calculations for both Gasbuggy and Rulison establish that the most distant zone that sequentially exceeds the fracture criteria three times is within the chimney or highly fractured region. The locations of these zones agree with the maximum distance at which it is necessary to hypothesize a sharp increase in permeability to match data from the gas-production and pressure-buildup tests. Having established a parameter related to extensive fracturing and permeability enhancement for single explosive sources, the first attempts at two-dimensional calculations of multiple explosive sources (detonated both sequentially and simultaneously) are presented. Two calculations of effects from sequentially detonated explosives indicate that, if the second explosive were located 5 cavity radii above the void or free surface created by the detonation of the first explosive, a permeable connection between the two fractured regions is assured. This translates to a spacing of 6 cavity radii from a previous explosion in which no chimney is formed, or 8.5 cavity radii from an explosion that produces a chimney height of 3.5 cavity radii. However, if the residual pressure in the lower void remains near overburden pressure, a permeable connection might not be obtained at larger spacings than above. Three calculations of effects from simultaneously detonated explosives indicate that the interval between the explosives is highly fractured to a radial distance that is more than 50% greater than that calculated for a single explosive. Also, the calculations indicate that the optimum spacing between such simultaneously detonated explosives is 8 to 10 cavity radii. This preliminary result is surprising, in that spacings required to ensure vertical chimney communication in the simultaneous detonation mode were expected to be smaller than those required for sequential firing. Further work to develop these calculational methods into predictive tools (especially for sequential detonations) is in progress. (auth)

507 ANALYSIS OF MARVEL: A NUCLEAR SHOCK-TUBE EXPERIMENT. Crowley, B. K.; Glenn, H. D.; Marks, R. E. (Univ. of California, Livermore). pp 277-300 of Peaceful Nuclear Explosions III. Applications, Characteristics, and Effects. Vienna; International Atomic Energy Agency (1974).

From panel on peaceful nuclear explosions, III: Applications, characteristics and effects; Vienna, Austria (27 Nov 1972). See STI/PUB-367; CONF-721143-.

Marvel, a nuclear-driven shock-tube experiment, consisted of a 2.2 kt nuclear explosive detonated 176 m underground at one end of a 122 m long, 1 m dia. horizontal tunnel. Vaporization of material in the immediate vicinity of the explosive provided the source of high-energy driver gas. The driven gas was the ambient atmo-

spheric air in the tunnel. Marvel was conducted as an experimental and calculational study of the time-dependent flow of energy in the tunnel and surrounding alluvium. The design of Marvel, the dynamic and post-shot experimental results, and a numerical simulation of the experiment are described. Experimental and calculational results indicate the following. The high-energy air shock travelled down the tunnel nearly 50 times faster than the shock in the surrounding alluvium. Over the first 30 m of the tunnel, the shock had a velocity of approximately Mach 380; during its 4 ms transit of the 122 m tunnel, it attenuated to approximately Mach 30. Significant ablation of material from the tunnel walls had the primary effect in attenuating the air shock. The source energy was preferentially channelled down the tunnel, and a cone-shaped cavity resulted. (auth)

508 RELATIVE RISKS FROM RADIONUCLIDES FOUND IN NUCLEARLY STIMULATED NATURAL GAS. Kelly, M. J.; Rohwer, P. S.; Barton, C. J.; Struxness, E. G. (Oak Ridge National Lab., TN). pp 321-339 of Peaceful Nuclear Explosions III. Applications, Characteristics, and Effects. Vienna; International Atomic Energy Agency (1974).

From panel on peaceful nuclear explosions, III: Applications, characteristics and effects; Vienna, Austria (27 Nov 1972). See STI/PUB-367; CONF-721143-.

The risks from man-made radionuclides in nuclearly-stimulated natural gas were treated by: ranking estimated radiation dose potentials for total quantities of radionuclides present; comparing projected individual and population doses expected from gas usage with doses to individuals and populations from other radiation sources; and comparing population dose risk projections with other risks encountered in everyday life. The radionuclides in gas, quantitatively determined from sample analyses were ^{3}H, ^{14}C, ^{37}A, ^{85}Kr, and ^{203}Hg. Other radionuclides, possibly present but below analytical detection limits, would represent a negligible addition to the potential annual dose. ^{3}H and ^{85}Kr deserve detailed consideration, since their dose potential is > 90% of the total estimate. At equal concentration, ^{3}H has the larger somatic and genetic risk. Device design can reduce tritium quantity; ^{85}Kr is determined by explosive yield and the fissionable material used. Although unlikely to dominate, the dose potential from ^{85}Kr may still represent an appreciable fraction of the total dose potential. Radionuclide concentrations in the gas are affected by (a) device design and shielding, (b) chemical constituents in the gas formation, and (c) device yield per unit of gas released. The exposure probability is controlled by the type of usage (i.e., residential versus industrial) and local climatology. The maximum exposure to a critical population group, excluding natural background radiation and medical exposure, should not exceed 170 mrem/yr (500 mrem/yr to an individual) and the dose from using nuclearly-stimulated gas should be but a small fraction of this. 4 pCi/cm^3 of ^{3}H in commercial natural gas would meet this criterion. The techniques and methods used are discussed and the derived dose estimates are compared to doses from other sources. Risk estimates (mortality probability from radiation-induced neoplasms or non-specific life shortening per person) are used to obtain somatic and genetic risk projections from the dose estimates. These projections are based on a linear dose-response relationship ignoring dose rate effects providing upper limit values. The calculated risk associated with gas use is then compared with similar estimates of risk associated with life in technologically developed nations. The numbers of deaths to be expected in an exposed population due to various accidents, heart disease, the natural incidence of cancer, are examples of other risks used for comparison. The intent is not to minimize the significance of the dose (and associated risks) from the use of nuclearly stimulated natural gas, although they may be small in comparison with other risks. To act responsibly, all reasonable steps must be undertaken to minimize the risks to man from this source. The purpose is to provide a perspective from which the radiation risk associated with use of this gas can be studied as an integral part of the cost-benefit analysis of nuclear gas stimulation technology. (auth)

509 PRODUCTION OF RADIOACTIVITY IN PEACEFUL NUCLEAR EXPLOSIONS. Siddons, R. A. (Atomic Weapons Research Establishment, Aldermaston, Eng.). pp 353-367 of Peaceful Nuclear Explosions III. Applications, Characteristics, and Effects. Vienna; International Atomic Energy Agency (1974).

From panel on peaceful nuclear explosions, III: applications, characteristics and effects; Vienna, Austria (27 Nov 1972). See STI/PUB-367; CONF-721143-.

The main features of the production of radioactivity in peaceful nuclear explosions are demonstrated by a systematic appraisal of freely available literature. The progress made in reducing the liberation of particularly undesirable activity, in the context of the application envisaged, is pointed out. Neutron-induced activity produced within the explosive itself depends on the design and cannot be independently determined without access to design details. However, order-of-magnitude estimates of the production are available, and there is evidence that predictions can be made with reasonable accuracy for specific designs. Fission-product activity and neutron-induced activity, including tritium, produced outside the explosive can be determined, per unit energy release, from published data. It is suggested that the information available forms an acceptable basis for an independent assessment of the radiological risk from any peaceful nuclear explosion project. (auth)

510 RADIOLOGICAL ACCIDENT PREDICTION AND TECHNIQUES FOR PRACTICAL OPERATIONAL CONTROL IN A NUCLEAR GAS STIMULATION PROJECT. Pastore, R. M. (Atomic Energy Commission, Las Vegas, NV); Gotchy, R. L. pp 369-387 of Peaceful Nuclear Explosions III. Applications, Characteristics, and Effects. Vienna; International Atomic Energy Agency (1974).

From panel on peaceful nuclear explosions, III: Applications, characteristics and effects; Vienna, Austria (27 Nov 1972). See STI/PUB-367; CONF-721143-.

Prompt venting of a deeply buried, gas-stimulation, nuclear detonation is not considered credible. Inadvertent leakage of gaseous radionuclides is assumed to occur at some time following the detonation through the most probable leak path, the annular region between the casing and the drilled hole. Darcy gas flow calculations using a driving pressure based on realistic cavity pressure growth are used to prepare a time history of leakage rates. The resulting radioactive effluent is then dispersed by air currents. In the improbable event of real leakage, Remote Area Monitors provide dose-rate readings which are used to estimate the radioactive leakage rate. Predictions of downwind dose-rates are based on local meteorological conditions. Operational decisions and action in the event of leakage are based on these near real-time predictions. (auth)

511 COMPUTER METHOD FOR PREDICTING FALLOUT LEVELS RESULTING FROM CRATERING NUCLEAR EXPLOSIONS APPLIED FOR PEACEFUL PURPOSES. Robson, A. (Atomic Weapons Research Establishment, Aldermaston, Eng.). pp 411-428 of Peaceful Nuclear Explosions III. Applications, Characteristics, and Effects. Vienna; International Atomic Energy Agency (1974).

From panel on peaceful nuclear explosions, III: Applications, characteristics and effects; Vienna, Austria (27 Nov 1972). See STI/PUB-367; CONF-721143-.

A cloud model is described which, in combination with a computer programme, DIFFAL, enables predictions to be made of the fallout levels in the first few tens to hundreds of kilometers downwind from nuclear explosions. The program may also be used to analyze the importance of the uncertainties attached to the meteorological and physical parameters involved. A comparison is given of the observed and predicted (H+1) hour dose rate isopleths for events Sedan, Teapot Ess and 1003 together with the maximum (H+1) hour dose rate for these events and Jangle-U. It is concluded that the method is suitable for predicting the fall-out levels arising from a nuclear cratering explosion in a relatively moist soil environment. The difficulties associated with fall-out prediction in the field are well understood. (auth)

512 POPULATION DOSES FROM UNDERGROUND NUCLEAR EXPLOSIONS. Edvarson, K.; Persson, G. (Swedish National Defence Dept., Stockholm). pp 429-439 of Peaceful Nuclear Explosions III. Applications, Characteristics, and Effects. Vienna; International Atomic Energy Agency (1974).

From panel on peaceful nuclear explosions, III: Applications, characteristics and effects; Vienna, Austria (27 Nov 1972). See STI/PUB-367; CONF-721143-.

An approximate model for estimating population doses and dose commitments due to atmospheric releases from underground nuclear explosions is discussed. The model is built on the fact that the population dose is mainly determined by the mean deposition and the population density within a given area—provided some general conditions are fulfilled. Hence, a detailed knowledge of the horizontal radioactivity distribution in the cloud is not necessary, only the approximate cloud-size and the mean horizontal transport velocity are required. Numerical estimates of population doses are made for some hypothetical cratering explosions. (auth)

513 MEASUREMENTS OF NEUTRON CROSS-SECTIONS WITH NUCLEAR EXPLOSIVES. Diven, B. C. (Los Alamos Scientific Lab., NM). pp 463-469 of Peaceful Nuclear Explosions III. Applications, Characteristics, and Effects. Vienna; International Atomic Energy Agency (1974).

From panel on peaceful nuclear explosions, III: Applications, characteristics and effects; Vienna, Austria (27 Nov 1972). STI/PUB-367; CONF-721143-.

One of the well-developed applications of nuclear explosives in-

volves their use as a source of neutrons to study nuclear properties of materials. A notable characteristic of neutron production in a nuclear explosive is the very large number of neutrons produced in a short time. Because of the high intensity and short time duration of the neutron pulse, this source is especially useful in the study of highly radioactive materials. Neutrons produced in an underground explosion are allowed to drift up an evacuated flight path 200 to 300 m in length to the surface of the ground where the experiments are performed. Neutrons with different velocities arrive at the experimental area at different times so that their energies are sorted out by the time of flight from source to detector, allowing detailed information to be obtained on the energy dependence of nuclear reactions. Advantages and disadvantages of the method are reviewed and methods of adjusting the neutron spectrum to match various experimental requirements are discussed. (auth)

514 SERIES OF HIGH GAIN, BROAD-BAND PORTABLE INSTRUMENTATION TO COLLECT SEISMIC AND STRUCTURAL MOTION DATA. Talpis, N. A.; King, K. W. (Earth Sciences Labs., Las Vegas, NV). pp 11-18 of Proceedings of the Nineteenth International ISA Aerospace Instrumentation Symposium. Washburn, B. (ed.). Pittsburgh; Instrument Society of America (1973).

From 19th international aerospace instrumentation symposium; Las Vegas, Nevada, USA (21 May 1973). See CONF-730510-.

The Earth Sciences Laboratories of the National Oceanic and Atmospheric Administration has utilized a series of high gain, broad-band ruggedized portable instrumentation to collect seismic and structural motion data. The instrumentation can record motion from $9 \times 5 \times 10^{-5}$ to 100 cm/sec velocity (10^{-6}g to 1g at 1 Hz). Transducers range from a rugged 10.5 pound accelerometer to a small velocity seismometer. Intergrating amplifiers convert the acceleration to velocity, a more useful tool. Built-in calibration oscillators provide field calibration capabilities. Data are recorded on magnetic tape or telemetered by radio or hardlines to remote recording sites. Small low-cost commercial VHF portable radio transmitters and receivers are repackaged for radio telemetry. The systems are extensively used to obtain building, bridge, and soil response data. (auth)

515 TEMPORAL CHANGES IN p-WAVE VELOCITY IN SOUTHERN CALIFORNIA. Kanamori, H.; Chung, W. Y. (California Inst. of Tech., Pasadena). Tectonophysics; 23: No. 1-2, 67-78 (Jul 1974).

P-wave delays at Tinemaha, China Lake, Pasadena, Riverside, Hayfield and Barrett, stations of the CIT Southern California seismic network, were measured for three explosions in the Aleutians and six deep-focus earthquakes in the Marianas. Except at Riverside, no change in P-delays exceeding the experimental uncertainty, ± 0.2 sec, is found during the period from 1965 to 1971. At Riverside, however, P-delay in 1971 is at least 0.4 sec smaller than that in 1965, indicating a temporal P-velocity increase beneath Riverside from 1965 to 1971. Evidence supporting this result is obtained from the P-times at Riverside for quarry blasts at Corona ($\Delta \approx 20$ km). Precise travel-time measurements are made for eight blasts since 1949. The travel time changes as a function of time, ranging from 3.3 to 3.7 sec. This range of variation seems to be larger than the experimental uncertainty. The trend for the period from 1964 to 1969 is consistent with the temporal change in the teleseismic P-delays observed at Riverside. The observed change in P-delays is not related in any obvious way to past seismic activity; rather it might represent a large-scale fluctuation of the property of the crust caused possibly by change in the tectonic stress and fluid-vapor flow, and may be related to future earthquake activity. (NL)

Protective Structures and Equipment

Refer also to abstract 572.

Safety Engineering

Refer also to abstract 1305.

ENVIRONMENTAL AND EARTH SCIENCES

Minerals and Ores

Refer also to abstracts 157 and 643.

516 (AEC-tr-7572) URANIUM DEPOSITS IN THE FRENCH MASSIF CENTRAL. Geffroy, J. Translated from pp 541-579 of Geologie, Geomorphologie et Structure Profonde du Massif Central Francais, Clermont-Ferrand, 1972. 55p. Dep. NTIS $5.75.

The potential of the uranium deposits in the French Massif Central is given, after a historical summary. Deposits are studied by districts, and divided into two general types: intragranitic veins, bodies and pipes (Limousin-Marche, Margeride, Forez, Morvan) and deposits in sedimentary layers: Permian (South of the Massif) and early-Cenozoic (Auvergne). (auth)

517 (NASA-CR-138231) APPLICABILITY OF REMOTE SENSOR DATA TO GEOLOGIC ANALYSIS OF THE BONANZA TEST SITE. Semiannual progress report, 1 October 1973-31 March 1974. Knepper, D. H.; Lee, K.; Butler, R. W.; Fisher, J. C.; Huntley, D. (Colorado School of Mines, Golden (USA)). May 1974. 30p. NTIS $4.50.

518 URANIUM DISTRIBUTION IN CRYSTALS OF ACCESSORY ZIRCONS. Eliseeva, O. P.; Ryabchikov, I. D.; Bogatyreva, N. A. (Inst. of Geology of Ore Deposits, Petrography, Mineralogy, and Geochemistry, Moscow). Geokhimiya; No. 9, 1389-1398 (Sep 1974). (In Russian).

Uranium behavior in crystals of accessory zircons from granitoids of Middle Asia and the Northern Kazakhstan has been studied by the method of fragmentation radiography. The following types of uranium distribution have been established: the uniform one, the concentrated, the zoned ones and that superposed over small fissures, which conform well to the peculiarities of the internal structure of the crystals of accessory zircons. The theory of the behavior of isomorphic admixtures during crystallization of the melts allowed to establish that the singled out types of uranium distribution correspond to cases of equalization of uranium and zirconium concentrations in the magma only at the expense of diffusion; to the rise of periods of intense magma mixing which disturbs the diffusion layer near the growing zircon crystals; to the nucleation of new crystals within the ranges of diffusion zones of grains having earlier begun to crystallize. (auth)

519 HELIUM LOSS THROUGH GRANITE MASSIFS AND ZONELS ENCLOSING RADIOACTIVE ORES. Tugarinov, A. I.; Osipov, Yu. G. Geokhimiya; No. 9, 1424-1429 (Sep 1974). (In Russian).

The ratio of two constituents (He_1 and He_2, where He_2 is the He formed during decay of radioactive products in ores) was followed in a series of samples from deposits of radioactive ores. The relative loss of He through zonels surrounding radioactive ores and through granite massifs and zonels surrounding radioactive mineralizations was tabulated. (JSR)

520 PECULIARITIES OF URANIUM DISTRIBUTION IN IGNEOUS ROCKS OF THE NORTHERN KAZAKHSTAN. Berzina, I. G.; Eliseeva, O. P.; Pipemko, D. P. (Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). Izv. Akad. Nauk SSSR, Ser. Geol.; No. 7, 16-31 (Jul 1973). (In Russian).

Gamma radiography was used to study the distribution of uranium in 200 rock intrusions in northern Kazakhstan and in 1700 pieces of accessory minerals separated from these rocks. Uranium was found in the rock-forming and accessory minerals, in submicro inclusions, and in intergranular seams and veins. The ratio between different forms of uranium dispersion depends on the U concentration in the magma, on rock crystallization conditions, and on subsequent deposition leading to U redistribution. In granitoids the U fraction is related to the accessory minerals and small inclusions. In extrusive, subvolcanic, and porphyritic vein rocks, the U is concentrated in the basic mass of rock. Autometasomatic, postmagmatic, and hypergenic processes lead to U redistribution and sorption on Fe and Ti oxides and hydroxides. Calculation of the U balance in granites showed that unchanged rock-forming minerals contain 3% of the total U, while 50% of the U is concentrated in the accessory minerals and 35% in the submicro inclusions, intergranular seams, and veins. (tr-INIS)

521 HEAVY RARE GASES FROM RABBIT LAKE (CANADA) AND THE OKLO MINE (GABON): NATURAL SPONTANEOUS CHAIN REACTIONS IN OLD URANIUM DEPOSITS. Drozd, R. J.; Hohenberg, C. M.; Morgan, C. J. (Washington Univ., St. Louis, Mo. (USA)). Earth Planet. Sci. Lett.; 23: No. 1, 28-33 (Aug 1974).

Xenon isotopic studies confirm natural spontaneous chain reactions at the Oklo mine site (Republic of Gabon) with an integrated neutron flux of approximately 4×10^{20} n/cm^2 and a duration between 14,000 and 70,000 years. Similar studies for the Rabbit Lake deposit (Saskatchewan), a slightly younger site with some evidence of continued geologic activity shows no evidence of self-supporting reactions. (auth)

Radioactive Effluents

Refer also to abstracts 510, 723, 837, 1297, 1298, 1301, and 1302.

522 (BNWL-1830) PACIFIC NORTHWEST LABORATORY MONTHLY ACTIVITIES REPORT, APRIL 1974. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). May 1974. Contract AT(45-1)-1830. 29p. Dep. NTIS $4.00.

Tests were made of the $NaOH-Na_2O_2$ fusion process for converting refractory PuO_2 to soluble forms. Optical and autoradiographic examination of mounts of 216-2-1A tile field sediments recovered from a core well in plutonium trench soil was completed. A titanium species in solution may be responsible for the slowed rate of desorption of Pu from 216-2-9 crib soil. Experiments were carried out to measure fractional release of radioactive particles from contaminated surface materials at elevated temperatures. Injection grouting is being evaluated as a means of preventing potential flow of liquid along monitoring well casing-soil interfaces in waste tank areas. (MCG)

Radioactivity Monitoring and Transport

Refer also to abstracts 719, 821, 825-831, 833, 835, 1291-1293, and 2227.

523 (CONF-741018-, pp 37-44) USE OF ENVIRONMENTAL MONITORING DATA IN DETERMINING BACKGROUND RADIATION DOSES. Garry, S. M.; Wilkie, W. H.; Hobbs, B. B.; Monroe, H. J.; Wallace, R. G.; Lobdell, J. L. Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population Exposures.

Comparison of background radiation doses reported in the literature with doses calculated from preoperational environmental monitoring data indicates, in general, that monitoring data can be used to estimate doses to individuals from background radiation. These procedures for estimating doses provide a basis for assessing any significant increase in dose that may result from the operation of a nuclear power plant. Doses to individuals from background radiation are estimated from preoperational environmental monitoring data for a nuclear power plant. Food categories, consumption rates, and dose commitment factors are listed; and the calculation of doses to individuals from radioactivity in the environment is described. Sample collection and laboratory procedures are described briefly. Models of ingestion, air submersion, inhalation, and ground concentration pathways are used to calculate the doses from 16 radionuclides. Ingestion doses are estimated from measured radionuclide concentrations in 10 food categories that represent the major portion of the human diet. Doses from air submersion and inhalation pathways are estimated from measurements of radionuclide concentrations in air. Doses received from terrestrial radioactivity are calculated from measurements of radionuclide concentrations in soil. Thermoluminescent dosimeters are used to estimate the total external background gamma doses, including doses received from cosmic radiation. (auth)

524 (CONF-741018-, pp 45-52) ENVIRONMENTAL RADIATION MEASUREMENTS USING IN SITU AND CORE SAMPLING TECHNIQUES. Dickson, H. W.; Kerr, G. D.; Perdue, P. T.; Abdullah, S. A. (Oak Ridge National Lab., TN). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population Exposures.

Dose rates from natural radionuclides and ^{137}Cs in soils of the Oak Ridge area were determined from in situ and core sample measurements. In situ gamma measurements were made with a spectrometer consisting of a 4096 channel analyzer and a 55 cm^3

Ge(Li) detector designed for this purpose. This equipment was transported in a mobile laboratory constructed in a large van that had a gasoline generator to provide electrical power at remote sites. A tape of spectral data and a soil core sample from each site were returned to ORNL for further analysis. Information on soil composition, density, and moisture content, and on the distribution of cesium in the soil was obtained from the core samples. Measurements of radionuclide concentrations in soil samples were made with a 4 × 4 inch NaI detector that was in a graded shield and shielded counting room. In situ spectra were analyzed by a computer program which identified and assigned energies to peaks, integrated the areas under the peaks, and calculated radionuclide concentrations based on a uniform distribution in the soil. The assumption of a uniform distribution was adequate only for natural radionuclides, but simple corrections can be made to the computer calculations for man-made radionuclides distributed on the surface or exponentially in the soil. For ^{137}Cs, a correction was used based on an exponential function fitted to the distribution measured in core samples. At typical sites in Oak Ridge, the dose rate determined from these measurements was about 5 μrad/hr. (auth)

525 (CONF-741018-, pp 73-78) ENTRAINMENT OF STRATOSPHERIC TRITIUM: ANOTHER RADIOLOGICAL ANOMALY OF THE ROCKY MOUNTAIN WEST. Bard, S. T. (NUS Corp., Inc., Rockville, MD). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population Exposures.

A pre-operational radiological surveillance program for the Fort St. Vrain Nuclear Generating Station has detected a source of population exposure unique to the Colorado front range. It was found that tritium concentrations in atmospheric water vapor could fluctuate by three orders of magnitude over a twenty-four hour period and may attain MPC levels for short intervals of time following a high yield thermonuclear atmospheric test. The results also substantiate the work of other investigators who have suggested that orographically induced atmospheric waves can significantly alter the height of the tropopause in the lee of the mountains and allow for the rapid transport of stratospheric air to the ground surface. (auth)

526 (KFK-2002) ISOLA: A FORTRAN IV CODE FOR THE CALCULATION OF THE LONG-TERM DOSE DISTRIBUTIONS IN THE VICINITY OF NUCLEAR INSTALLATIONS. Huebschmann, W.; Nagel, D. (Kernforschungszentrum Karlsruhe (F. R. Germany). Abt. Strahlenschutz und Sicherheit). Jul 1974. 14p. (In German). Dep. NTIS (U. S. Sales Only) $4.00.

The computer code ISOLA is used to calculate the annual radiation doses caused by α- and β-active off-gases in the environment of the Karlsruhe Nuclear Research Center. The program is currently adapted to rising requirements in terms of accuracy and sophistication. It is described here in its present form. Up to 15 emitters may be coped with simultaneously. The emission rates are considered to be constant over the given time interval. Optionally either the isodoses chart of a specified area (for instance a square 20 by 20 km) or a list of doses calculated at up to 2000 locations (for instance the living areas) in the environment may be set up. Input and output are shown for a specific case. (auth)

527 (SZS-161) RESULTS OF FALLOUT MONITORING IN THE GERMAN DEMOCRATIC REPUBLIC IN 1972. Kunert, J.; Zindler, H. (Staatliche Zentrale fuer Strahlenschutz, Berlin (German Democratic Republic)). Jun 1974. 44p. (In German). Dep. NTIS (US Sales Only) $5.25.

The results of monitoring of air, precipitation, fallout, water, soil, plants and foodstuffs are presented. In spite of the influx of fresh fission products the gross beta activity deposited on the territory of the GDR was lower than in the preceding year (about 35% of 1971). The yearly deposition of ^{90}Sr and ^{137}Cs was about 40% of 1971. Only soil and grass, however, showed a slight decrease of ^{90}Sr concentration. On the contrary, there was a distinct decrease of ^{137}Cs contents in plant materials and milk. No changes of radionuclide levels could be detected in water, meat, and diet. (auth)

Atmosphere

Refer also to abstracts 511, 512, and 722.

528 (AD-779061) EVALUATION OF THE SENSITIVITY OF FALLOUT PREDICTIONS TO UNCERTAINTIES IN METEOROLOGICAL DATA. Final Report. England, W. G.; Sheridan, R. S. (Systems, Science and Software, La Jolla, Calif. (USA)). 1 May 1973. Contract DNA001-72-C-0214. 187p. (SSS-R-73-1615). NTIS $5.50.

The Defense Land Fallout Interpretive Code (DELFIC) was used to determine the sensitivity of fallout predictions to input meteorological data. Weapon yields considered were 1, 10, and 100 kt and 1 mt. Burst locations were Washington, DC, and Seattle, Washington. Forecasted, observed, and degraded meteorological data inputs were considered. (auth)

529 (ANL-8096, pp 111-112) INORGANIC CHEMISTRY. Apr 1974.

In Chemistry Division annual report, July 1972-June 1973.

An apparatus was built for measuring radon retention by O_2SbF_6 and other oxidants from radon-air mixtures similar to those found in uranium mines. The new apparatus will allow retention measurements to be made with ^{222}Rn concentrations of 100 to 100,000 pCi/liter and with airflow rates of 0.05 to 1.5 liter/min. It will also allow measurements to be made from 10 to 40°C, simulating conditions in uranium mines. Samples of O_2SbF_6 were prepared and examined spectrophotometrically. Two other salts, N_2FSbF_6 and $N_2F_3Sb_2F_{11}$, were prepared and tested as to oxidizing properties for the noble gases. Results indicate that O_2SbF_6 is probably more suitable for air purification purposes. (JGB)

530 (UCRL-51658) PROPOSED RAINOUT HAZARD MODEL FOR SYSTEMS ANALYSIS STUDIES. Harvey, T. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Sep 1974. Contract W-7405-eng-48. 10p. Dep. NTIS $4.00.

Rainout from nuclear airbursts presents a potential residual radiation hazard to civilian populations. A rainout hazard model for use in nuclear weapon system studies is proposed. The model includes a summer synoptic weather system, a large-cloud diffusion code, and a simple demographic distribution of a heavily populated industrialized area. A primitive estimate of the number of casualties that might be expected from a 1-kt airburst weapon is calculated. (auth)

531 THE RATIOS OF FISSION PRODUCT PAIRS WITH SIMILAR HALF-LIVES IN THE ATMOSPHERE. Holloway, R.W.; Sumerlin, N.G.; Beck, J.N.; Kuroda, P.K. (Department of Chemistry, University of Arkansas, Fayetteville, Arkansas 72701). J. Geophys. Res. 79: No. 30, 4453-4459 (20 Oct 1974).

The ratios of pairs of fission products with similar half-lives (58.5-day ^{91}Y to 50.8-day ^{89}Sr and 13.6-day ^{143}Pr to 12.8-day ^{140}Ba) were measured radiochemically in a series of rain samples collected at Fayetteville (36°N, 94°W), Arkansas, after the Chinese explosions of March 18, 1972 (the fourteenth test), and of June 27, 1973 (the fifteenth test). The activity ratios in rain were found to show a marked variation: the $^{91}Y/^{89}Sr$ ratio in rain varied between the extreme values of 0.29 (March 24, 1972) and 10 (April 3, 1972), and the $^{143}Pr/^{140}Ba$ ratio varied from 0.21 (March 24, 1972) to 6.3 (April 13 and 14, 1972). The observed large variations of the activity ratios appear to be attributable to the difference in size distributions of particulate matter in rain. The ^{91}Y and ^{143}Pr become highly enriched in particles larger than a few microns in size, in relation to ^{89}Sr and ^{140}Ba, respectively, whereas the reverse appears to be the case in smaller submicron size particles. A similar trend was found in the data obtained after the seventh Chinese test of December 24, 1967. The results indicate that these isotopic pairs may turn out to be extremely useful as atmospheric tracers in the studies of meteorological phenomena. (auth)

532 MEAN RESIDENCE TIMES OF THE LONG-LIVED RADON DAUGHTERS IN THE ATMOSPHERE. Gavini, M.B.; Beck, J.N.; Kuroda, P.K. (Department of Chemistry, University of Arkansas, Fayetteville, Arkansas 72701). J. Geophys. Res. 79: No. 30, 4447-4452 (20 Oct 1974).

The activities of ^{210}Pb, ^{210}Bi, and ^{210}Po were measured in 17 rain samples that were collected at Fayetteville, Arkansas, during the months of April-June 1973, and ^{210}Pb and ^{210}Po only were measured in 52 additional rain samples collected during the months of September-December 1973 and January-April 1974. In approximately 70% of the cases (12 out of 17 rains) the residence times calculated from the $^{210}Bi/^{210}Pb$ and $^{210}Po/^{210}Pb$ ratios were either concordant or near concordant. In about 30% of the cases (5 out of 17 rains) the $^{210}Bi/^{210}Pb$ ratios yielded mean residence time values of 3 to 6 days, whereas the values calculated from the $^{210}Po/^{210}Pb$ ratios varied from 16 to 40 days. The discordant residence times can be shown to result from the mixing of two different air masses: one represented by a short and the other by a much longer residence time of the radon daughters. In order to test this idea the radionuclides ^{210}Pb and ^{210}Po were sequentially sampled from three rainstorms that occurred at Fayetteville, Arkansas, on October 6, 1973, February 18, and April 18, 1974. In the case of the October 6, 1973, rain the $^{210}Po/^{210}Pb$ ratio was found to vary markedly within a single rainfall, and the data indicated that a mixing of two air masses occurred during the rainstorm: one air mass was represented by a residence time of about 30 days and the other by

roughly 300 days. These values are suggestive of the mean residence times of aerosols for the entire troposphere (about 30 days) and for the entire stratosphere (about 1 year) frequently mentioned by previous investigators. In the case of the April 18, 1974, rain the mean residence time calculated from the $^{210}Po/^{210}Pb$ ratios remained fairly constant at about 30 days, whereas the February 18, 1974, rain was an intermediate case, and the mean residence time varied between 39 and 135 days. (auth)

533 ATMOSPHERIC TRITIUM-BUDGET, DISTRIBUTION, AND TRACER APPLICATIONS. Mason, A. S. Coral Gables, FL; Univ. of Miami (1974). 72p. University Microfilms Order No. 74-23,404.

Thesis (Ph. D.).

The development of instrumentation for sampling tritium as tritiated water (HTO) and tritiated free hydrogen (HT) in the upper troposphere and lower stratosphere was carried out. Equipment was utilized on a number of sampling flights. The resulting data indicated that HTO mixing ratios are typical of the source regions of the air, and that water turnover times increase exponentially upward between the tropopause and the ca. 150 mb level. This region exhibits a characteristic time of two years. The HTO mixing ratio ceases to increase in the middle stratosphere. Nearly uniform vertical profiles of the HT mixing ratio were found, except during periods of perturbation by underground nuclear weapons testing. The upper tropospheric HT mixing ratio was used to parameterize the interhemispheric air exchange time and the chemical hydrogen lifetime. Recent estimates of 2 years for the latter lead to unreasonably rapid interhemispheric exchange estimates. A chemical lifetime of about 10 years is indicated by this work. (Diss. Abstr. Int., B)

Soil

534 (BNWL-1721) EXPERIMENTAL METHODS FOR OBTAINING PERCOL MODEL INPUT AND VERIFICATION DATA. Serne, R. J.; Routson, R. C.; Cochran, D. A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1973. Contract AT(45-1)-1830. 38p. Dep. NTIS $4.00.

A soil-waste chemical equilibrium model, PERCOL, was developed to numerically simulate the complex chemical reactions that occur while a solution is percolating through porous media. Experimental procedures for measuring PERCOL model input verification parameters are described, including procedures for preparing both saturated and unsaturated experimental soil columns. Two methods of determining the soil-cation-exchange, capacity and soil exchange selectivity constants are presented. Methods for determining the initial soil conditions, a procedure for measuring the apparent porosity of a soil column and an empirical determination of trace ion sorption are also described. (auth)

535 (PB-232179) TRANSPORT OF RADIOISOTOPES BY FINE PARTICULATE MATTER IN AQUIFERS. Champlin, J. B. F. (Georgia Inst. of Tech., Atlanta (USA)). Dec 1969. Contract DI-14-01-0001-1629. 200p. NTIS $5.50.

Information on the long-term movement of radioactive fission products and other pollutants from waste pits, fallout, and underground nuclear explosions is persued through theoretical and experimental investigations of the various phenomena that pertain to ion transport or retention by soils. The theoretical section explores the interactions between solids in water that result from thermal forces, electrostatic charges, and Van der Waals forces. The particle range considered is that of the large colloid to the finest silt. Special attention is given to sources of energy sufficient to cause breakage of adsorption bonds, additive bonding, and the relationship between suspended particles and the granules making up the aquifer. The experimental section explores factors which influence either retention of radioactivity by the sand bed or transport of the activity through such a bed by micro-particles. (GRA)

536 MIGRATSIYA RADIOAKTIVNYKH PRODUKTOV GLOBAL'NYKH VYPADENII V POCHVAKH. (Migration of Radioactive Fallout Products in Soils). Pavlotskaya, F. I. Moscow; Atomizdat (1974). 216p.

The effect of the physical and chemical properties of the main, long-lived radionuclides on their behavior in soils is considered. Particular attention is devoted to the specific behavior of the radionuclides, the role of primary soil particles (genesis, chemical and mineralogical composition, crystal structure, etc.) and of organic matter of soils in processes of absorption and the binding strength of radionuclides with soils. An attempt is made to establish the chemical composition of compounds which settle on the earth's surface and migrate into the soils. (82 tables, 71 illustrations, 609 references) (SJR)

Water

Refer also to abstract 43.

537 (USGS-474-205) RADIOCHEMICAL MONITORING OF WATER AFTER THE CANNIKIN EVENT, AMCHITKA ISLAND, ALASKA, AUGUST 1973. Amchitka-42. Ballance, W. C. (Geological Survey, Lakewood, Colo. (USA)). Oct 1974. Contract AT(29-2)-474. 20p. Dep. NTIS $4.00.

Radiochemical data from the Amchitka Island study area were obtained from water samples collected by the U. S. Geological Survey during August 1973. Tritium determinations were made on 86 samples collected and gross alpha and gross beta/gamma determinations were made on 38 samples. The range of data for these samples was equal or less than the range of values obtained before the Cannikin event. (auth)

538 THE DETERMINATION OF AIR–SEA EXCHANGE AND OCEANIC MIXING RATES USING ^{7}Be DURING THE BOMEX EXPERIMENT. Young, J.A.; Silker, W.B. (Radiological Sciences Department, Battelle, Pacific Northwest Laboratories, Richland, Washington 99352). J. Geophys. Res. 79: No. 30, 4481-4490 (20 Oct 1974).

The concentrations of ^{7}Be and other radionuclides were measured in air, rain, and seawater in a region east of Barbados, British West Indies, in the summers of 1968 and 1969 during the Barbados Oceanographic and Meteorological Experiment. The radionuclide inventories in the sea varied rapidly owing to the horizontal motion of seawater through the sampling region. The salinity also varied considerably, presumably as a result of Amazon River water carried into the sampling region by the Guiana current, which flows northwestward along the coast of South America. The ^{103}Ru to ^{95}Zr ratio in the top 15 m of the sea indicated that large amounts of these radionuclides from the French nuclear test series at 23°S beginning July 7, 1968, were transported into the sampling region, probably by the Guiana current, on August 15, 1968, and also in June but not in May of 1969. The deposition of ^{7}Be on the sea surface by rainfall in the sampling region in August 1968 and May through July 1969 was only 13 and 26%, respectively, of that necessary to maintain the measured inventories. It is possible, however, that the inventories resulted from wet deposition outside the sampling region, such as in the intertropical convergence zone, followed by advective transport of the water into the sampling region. The calculated average deposition velocity of ^{7}Be was 1.0 cm/s, and the calculated average yearly ^{7}Be flux across the sea surface was 1.6×10^{-2} atom cm^{-2} s^{-1}. The calculated vertical eddy diffusion coefficient in the sea decreased from greater than 7 cm^2/s at the surface to 0.25–0.85 cm^2/s at 30–40 m. (auth)

539 RADIUM-226 AND Ra-Ba RELATIONSHIPS IN ANTARCTIC AND PACIFIC WATERS. Chung, Y.-C. (Scripps Institution of Oceanography, La Jolla, Calif. (USA)). Earth Planet. Sci. Lett.; 23: No. 1, 125-135(Aug 1974).

Three ^{226}Ra concentration profiles have been measured from the Antarctic south of New Zealand. These profiles show that the Ra concentration in the deep- and bottom-water region is fairly uniform at about 9.2×10^{-14} g/kg. However, south of the Antarctic Convergence, a slightly lower Ra concentration associated with higher salinity is found near the bottom where the Ross Sea Bottom Water spreads. In the Antarctic surface water, a gradual increase of radium concentration is observed from north to south across the Convergence. These features are closely correlated with the hydrographic data. The Ra concentration in the deep water increases from the North Atlantic through the Antarctic to the Pacific by a factor of three. In the Pacific, it increases from the southwest to the northeast. The trend of increase is similar to the abyssal water temperature, and shows that Ra, like heat, is injected continually into the deep water column as the water circulates. Ra and Ba are not linearly correlated over the entire ocean. The Ra/Ba ratio is not constant, and tends to increase from the surface water to the bottom water due to different input mechanisms for these two elements in the ocean. (auth)

540 GEOSECS NORTH ATLANTIC RADIOCARBON AND TRITIUM RESULTS. Oestlund, H. G.; Dorsey, H. G.; Rooth, C. G. (Miami Univ., Fla. (USA). Rosenstiel School of Marine and Atmospheric Sciences). Earth Planet. Sci. Lett.; 23: No. 1, 69-86(Aug 1974).

Radiocarbon data for 11 stations and tritium data for 16 stations in the North Atlantic Ocean from 74°N to 3°N are presented. For radiocarbon, normal errors in $\Delta^{14}C$ are ±4‰. and in tritium, ±0.09 TU or ±2%, whichever is larger. There is a remarkable, but not simply linear, correlation between oceanic bomb transients in ^{14}C and ^{3}H. The deep convective mixing in the Greenland Sea is reflected in substantial bomb tracer penetration to all depths, with residence time for the deep, cold core water that seems to be 20 to 30 years. The outflow in the bottom layer southward over

the sills of the Denmark Strait and Faroe Passage carries significant tritium concentration, at least to 40°N. Complicated, but coherent, profile structures in the subtropical Atlantic suggest effects of large-scale lateral advection. In particular, a pronounced minimum in both ^{14}C and ^{3}H might be associated with the Antarctic intermediate water. (auth)

541 UNIVERSITY OF WASHINGTON GEOSECS NORTH ATLANTIC CARBON-14 RESULTS. Stuiver, M.; Robinson, S. W. (Washington Univ., Seattle (USA). Dept. of Geology). Earth Planet. Sci. Lett.; 23: No. 1, 87-90(Aug 1974).

The ^{14}C activities of North Atlantic water at Geosecs stations 5, 27, and 29 are reported. The influence of the correction for isotope fractionation on the ^{14}C results is discussed, and experimental procedures are given. (auth)

542 THE TRITIUM AND CARBON-14 PROFILES AT THE GEOSECS I (1969) AND GOGO I (1971) NORTH PACIFIC STATIONS. Roether, W. (Columbia Univ., Palisades, N. Y. (USA). Lamont-Doherty Geological Observatory). Earth Planet. Sci. Lett.; 23: No. 1, 108-115(Aug 1974).

Tritium and ^{14}C data of the "GOGO I" station at 28.5°N, 121.6°W in November 1971 are reported. The tritium decline between 150 and 350 m depth is as pronounced as was observed on a previous occupation of the same position, station "Geosecs I" in September 1969, and the tritium concentrations below 200 m are unchanged. ^{14}C data from the depth range of tritium decline are corrected for fallout ^{14}C contribution. The correcting procedure requires simultaneous measurements of ^{14}C, ΣCO_2, and tritium. It is concluded that the natural absolute ^{14}C concentration attains a maximum near 400 m depth, of 7.5% excess over that of surface water. (auth)

543 RADIUM-226 MEASUREMENTS FROM THREE GEOSECS INTERCALIBRATION STATIONS. Chung, Y.; Craig, H. (Scripps Institution of Oceanography, La Jolla, Calif. (USA)); Ku, T. L. (University of Southern California, Los Angeles (USA)); Goddard, J.; Broecker, W. S. (Columbia Univ., Palisades, N. Y. (USA). Lamont-Doherty Geological Observatory). Earth Planet. Sci. Lett.; 23: No. 1, 116-124(Aug 1974).

Results are presented of ^{226}Ra intercalibration measurements made by three groups of investigators (LDGO, USC, and SIO) on the seawater samples collected in profile at three Geosecs intercalibration stations. A common radium standard prepared from an NBS bulk standard for the Geosecs program was adopted by all groups. At Geosecs-I station in the Northeast Pacific, the new ^{226}Ra results obtained from reoccupation of the station show that the agreement of the three groups was significantly improved over the initial comparison made in 1970. At Geosecs-II in the Northwest Atlantic the initial comparison of the ^{226}Ra profiles showed that the USC data were systematically higher than the SIO data by 1 radium unit of 10^{-14} g/kg. This corresponds to a relative difference of 20% due to the very low radium content of Atlantic waters. The new results obtained from reoccupation of the station show that both the USC and SIO data are consistent with their previous data. Thus, a systematic difference of 1 radium unit still exists. However, the new LDGO profile falls in between those of USC and SIO, lying closer to the SIO profile. At Geosecs-III station in the Southwest Pacific, the ^{226}Ra measurements show that the LDGO data are systematically higher than the SIO data by about 10% above 3.4 km depth. Below this depth, both sets of data agree and show a sharp decrease in radium concentration. This radium discontinuity corresponds to the benthic front which is a density discontinuity separating the Deep and Bottom Water in the South Pacific. (auth)

Ecosystems and Food Cycles

544 (IAEA-163) ACTIVITIES OF THE INTERNATIONAL LABORATORY OF MARINE RADIOACTIVITY, 1974 REPORT. (International Atomic Energy Agency, Vienna (Austria)). Jun 1974. 179p. Dep. NTIS (US Sales Only) $12.00.

Separate abstracts were prepared for 14 sections of this report. An additional section discussed the interactions of Cl with seawater and dissolved organic matter. (CH)

For abstracts of individual sections see: 43, 545-553, 568, 906, 907, and 925.

545 (IAEA-163, pp 11-20) RELATIVE IMPORTANCE OF FOOD AND WATER PATHWAYS IN THE BIO-ACCUMULATION OF ^{65}Zn. Renfro, W. C.; Fowler, S. W.; Heyraud, M.; LaRosa, J. Jun 1974.

Results are reported from studies on the uptake of ^{65}Zn by marine invertebrates in tanks of seawater when ^{65}Zn was made available via food and via water. Data are presented from preliminary studies on crabs, shrimp, and mussels. (CH)

546 (IAEA-163, pp 28-32) ACCUMULATION AND RETENTION OF ^{241}Am IN MARINE PLANKTON. Fowler, S. W.; Heyraud, M. Jun 1974.

Americium-241 uptake and retention by marine zooplankton in tanks of seawater were measured. The results suggest that surface adsorption plays a significant role in ^{241}Am uptake by zooplankton. (CH)

547 (IAEA-163, pp 33-43) SEDIMENT-WORM INTERACTIONS: TRANSFER OF ^{65}Zn, ^{109}Cd, AND ^{110m}Ag FROM MARINE SEDIMENT BY NEREIS DIVERSICOLOR. Renfro, W. C.; Benayoun, G. Jun 1974.

In estuarine and coastal environments the sorption of heavy metals and organic compounds to sedimentary particles appears to be an important mechanism for concentrating pollutants on bottom sediments. If the sediment in some marine areas serves as a reservoir for contaminants, it might also be a source of toxic contaminants to marine benthic organisms. Previous work has shown that the marine polychaete worm, Nereis diversicolor, could accumulate small but measurable amounts of Zn and also promote the release of Zn from marine sediment. Additional radiotracer experiments in the field and laboratory were designed to understand more about the role of benthic worms in transferring metals from sediments to marine food webs. Zinc-65, ^{109}Cd, and ^{110m}As were used as tracers in the studies reported. (CH)

548 (IAEA-163, pp 43-55) FLUX OF ^{109}Cd THROUGH EUPHAUSIIDS. Fowler, S. W.; Benayoun, G.; Oregioni, B. Jun 1974.

Studies on the flux of cadmium through euphausiids were initiated to assess the role an abundant zooplankter plays in cycling this element through the marine ecosystem. The aim of the study was to define the principal modes of accumulation and excretion of cadmium by zooplankton and to integrate these values into a linear model describing the cadmium budget. The common Mediterranean euphausiid, Meganyctiphanes norvegica, and ^{109}Cd were used for all experiments. (CH)

549 (IAEA-163, pp 62-70) BIOLOGICALLY TRANSFORMED ^{65}Zn AND ITS SUBSEQUENT AVAILABILITY TO MARINE BIOTA. Fowler, S. W.; Heyraud, M. Jun 1974.

The influence of biologically derived Zn complexes on the cycling of ^{65}Zn in marine food chains was investigated using ^{65}Zn and shrimp (Lysmata seticaudata) and mussels (mytilus galloprovincialis) in a seawater aquarium. Results showed that biologically derived Zn complexes were excreted in feces by shrimp and in both shrimp and mussels the uptake of ^{65}Zn was significantly reduced in water containing naturally complexed ^{65}Zn. (CH)

550 (IAEA-163, pp 94-96) DISTRIBUTION COEFFICIENT OF PLUTONIUM BETWEEN SEDIMENT AND SEA WATER. Duursma, E. K.; Parsi, P. Jun 1974.

A series of studies was conducted to determine the distribution coefficient of Pu onto marine sediments under both anoxic and oxic conditions. Plutonium-237 was added to seawater in three different valence states: III, IV, and VI. Data are presented on the distribution coefficients of the different Pu valence states for Mediterranean sediment. For both anoxic and oxic conditions the distribution coefficients were similar for all three Pu valence states. (CH)

551 (IAEA-163, pp 96-103) ADSORPTION AND DESORPTION OF PLUTONIUM AND AMERICIUM IN FRESH WATER-SEDIMENT AND SEA WATER-SEDIMENT SYSTEMS. Fukai, R.; Murray, C. N. Jun 1974.

Adsorption and desorption processes were proposed as a regulating mechanism in the cycling of trace metals and of radionuclides in estuaries. Results are reported from measurements in laboratory experiments using ^{237}Pu and ^{241}Am as tracers. (CH)

552 (IAEA-163, pp 107-108) FIXATION OF RADIONUCLIDES WITH TIME BY MARINE SEDIMENTS. Duursma, E. K.; Parsi, P.; Statham, G. Jun 1974.

Sorption of radionuclides by sedimentary particles is a time dependent process in which the adsorption on the surface of the particle is relatively rapid (minutes, hours, days) and the absorption into sediment particles is relatively slow (weeks, months, years). The release to the water phase of radionuclides from contaminated sediments as a consequence of desorption or loss by other means depends on their degree of binding. When the radionuclides have been in contact with the sediments for long periods of time, the possibility exists that the ease of removal decreases due to complex surface reactions or binding within crystal matrices. Laboratory experiments were performed to verify field data obtained under semi-natural conditions that

relate to this question. The experiments were performed by mixing 50 g of Mediterranean sediment with 10 liters of seawater in several lots, each containing approximately 1 μCi/l of radiotracer; stable metal experiments utilized 100 μg/l additions of stable metals and 1 g/l of sediment. The degree of fixation was determined by the degree of release of the radionuclide or trace metal after leaching by 1N acetic acid/NH_4-acetate solution (pH 5.4), and 1N acetic acid. Radionuclide concentrations in the leachates were determined by γ or β counting and the stable metal concentrations by anodic stripping voltammetry. Results are reported from studies using radionuclides of Mn, Fe, Co, Cu, Zn, Sr, Ru, As, Cd, Co, Ce, and Pb as tracers. Of all elements studied, only Cd and Sr were completely leachable by both solutions after a sorption period of seven months, while Ag was the only element completely fixed. (CH)

553 (IAEA-163, pp 134-138) RADIONUCLIDE MEASUREMENTS OF WATER, SEDIMENT, AND BIOTA COLLECTED FROM THE LIGURIAN SEA: $^{239,240}Pu$, ^{90}Sr, AND ^{137}Cs. Fukai, R.; Murray, C. N.; Statham, G.; Asari, K. Jun 1974.

There are virtually no published results that show existing levels of fallout ^{239}Pu and ^{240}Pu in Mediterranean seawater. Measurements were therfore undertaken to obtain data for comparison with measurements of Pu made elsewhere in the world oceans. Strontium-90 and ^{137}Cs determinations were included in a limited number of samples (seawater) to contrast their distributions with those of ^{239}Pu and ^{240}Pu. (auth)

554 GIGIENICHESKIE VOPROSY IZUCHENIYA SODERZHANIYA URANA VO VNESHNEI SREDE I EGO VLIYANIYA NA ORGANISM. (Health Problems in Studying Uranium Content in the Environment and its Effect on the Organism). Novikov, Yu. V. Moscow; Meditsina (1974). 232p.

This monograph deals with the health problems in studying the uranium content in various elements of the environment (minerals, soil, atmosphere, water, and food products). These problems are closely connected with the effect of small concentrations of uranium in the environment on the health of human populations and on the human organism. This problem is of practical and theoretical importance. Material on the health aspects of uranium migration in the environment is exhaustively discussed. Particular attention is devoted to the entry of uranium into the human organism with the daily diet in regions with an increased uranium content in the environment. A special section deals with the content of uranium in humans and animals. Problems of the entry, distribution, and excretion of uranium from the organism are considered in detail. Space is devoted to the experimental toxicology of soluble uranium compounds. It is shown that uranium is not only a liver poison, but that it also damages other organs such as the kidneys, gastrointestinal tract, nervous system, endocrine system, and systems dealing with food metabolism and water exchange. Biochemical, functional, and morphological changes which develop during severe and chronic intoxication are described in detail. Various changes in blood composition and enzyme systems are described. (SJR)

555 INTAKE OF ^{90}Sr AND ^{137}Cs WITH FOOD BY THE URBAN POPULATION OF USSR IN 1966-1971. Petukhova, E. V. Gig. Sanit.; No. 9, 38-41(1974). (In Russian).

The paper presents data on ^{90}Sr and ^{137}Cs intake with food ration by certain age groups of urban population in 1966 to 1971. The finding was that the average level of ^{90}Sr received by a person of the urban population in 1970 and 1971 in comparison with that in 1966 decreased 1.6 times and that of ^{137}Cs—3 times. The level of ^{90}Sr intake by urban population all over the country in 1971 was at an average of 6.5% of the standard annual permissible intake (NRB-69). The sanitary significance of ^{137}Cs was approximately 5 times lower than the sanitary significance of ^{90}Sr. (auth)

556 SOME ASPECTS OF ^{137}Cs IN HUMAN RADIOECOLOGY. Lloyd, R. D. Salt Lake City; Univ. of Utah (1974). vp. Thesis.

A model was developed, which relates the ^{137}Cs in humans to the ^{137}Cs in their milk supply. The data on which the model was based included periodic measurements of fallout ^{137}Cs in residents of 19 Utah dairy farms during the years 1962 through 1966, and in monthly collections of milk produced on these 19 farms over the same period of time. Also important to the model were the values determined for the equivalent biological half-times for ^{137}Cs in men, women, juveniles, and infants, which were shown to depend strongly on age for juveniles and infants, and on sex for adults, but not on body mass. Parameters such as average daily milk consumption and fraction of ^{137}Cs intake accounted for by milk were also considered in the model. Extension of this model to residents of 9 North American cities indicated its applicability to other similar populations. Appropriate adaptations could prove to be of utility in the prospective or retrospective projections of human ^{137}Cs body burdens produced by contaminating nuclear events for which estimates of ^{137}Cs in milk are available by model or by measurement. Use of the model to predict the human body content of ^{137}Cs resulting from ^{137}Cs in reactor effluents showed that beginning with the first milk sample in which an elevated ^{137}Cs concentration can be identified, there should be some weeks or months available to plan protective measures which are designed to reduce the radiation exposure to the human population that would result from an accidental release of this radionuclide. (Diss. Abstr. Int., B)

Radiometric Techniques

Refer also to abstracts 48, 540-543, 642, and 647.

557 (AD-780121) HISTORICAL CLIMATOLOGY. Final Technical Report. Libby, L. M. (R and D Associates, Santa Monica, Calif. (USA)). Feb 1974. 95p. NTIS $4.00.

A methodology for evaluation of past climates in historic times was examined from a theoretical basis and its evaluation was initiated. The principle is that the ratios of stable isotopes in a tree depend on the temperature at which its wood is manufactured as well as on the temperature at which precipitation that nourishes the tree is produced. By measuring stable isotope ratios in a chronological sequence of dated tree rings, changes in climate may be evaluated. A tree has been so measured for the years 1700-1950 and compared with the thermometer record for those years to obtain phenomenological (numerical) temperature coefficients for the ratios of hydrogen, carbon, and oxygen. A second tree has been measured for the years 1500-1800 and found to show the low temperatures of the little ice age with warm brief intervals at about 1570, 1650, 1730 and 1790. A theoretical study of various aspects of the total carbon inventory on the earth's surface has been initiated. (auth)

558 METHODS OF INTRODUCING CORRECTIONS INTO INDICATIONS OF THE NEUTRON GAMMA-METHOD IN DETERMINING ROCK POROSITY. Lakhnyuk, V. M. Dopov. Akad. Nauk Ukr. RSR, Ser. B; No. 8, 704-706(Sep 1974). (In Ukrainian).

An expediency is substantiated for introducing various corrections into indications of the neutron gamma-method (NGM) by creating for the rock's porosity estimation a mathematic model which uses non-corrected NGM indications and parameters characterizing distorting factors. It is shown that the suggested method provides a greater accuracy of the porosity estimation from the NGM data than an ordinary procedure of taking into account the distorting factors. (auth)

559 USE OF THE RUBIDIUM-STRONTIUM METHOD FOR DATING OF A SCHIST OF LIGHTLY METAMORPHOSED SEDIMENTS: APPLICATION TO PRECAMBRIAN II OF THE BOU AZZER-EL GRAARA WINDOW (ANTI-ATLAS, MOROCCO). Clauer, N. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Centre de Sedimentologie et Geochimie de la Surface). Earth Planet. Sci. Lett.; 22: No. 4, 404-412(Jul 1974). (In French).

Precambrian II sediments of the Bou Azzer-El Graara window are very lightly metamorphosed. They extend progressively from the anchimetamorphic zone, a phase between deep diagenesis and metamorphism, to the epimetamorphic zone. From the anchimetamorphic zone onwards, the fine fractions (<2μ) of the sediments lose all characteristics of their previous history; early and/or late diagenesis, detrital remnant, to record the effects and the time of metamorphism. Their reaction is identical to that of the fine fractions smaller than 2 microns of the epimetamorphic zone. The end of the metamorphism studied here took place 602 ± 18 m.y. ago, with $\lambda\ ^{87}Rb = 1.47 \times 10^{-11}$ year^{-1}, during the Pan-African event. In very highly metamorphosed zones, plotting of whole-rock points on a $|^{87}Rb/^{86}Sr, {}^{87}Sr/^{86}Sr|$ diagram depends as much, if not more, on their petrographic characteristics as on the degree of metamorphism reached. Therefore, carbonate rocks are chemical systems open to all the phases of transformation, as they do not contain minerals susceptible of receiving all the strontium released by the carbonates. The silty rocks, on the contrary, only form a completely open chemical system as from the moment when the degree of metamorphism reached is such that all detrital minerals become open to allow homogenization and redistribution of the total strontium of the rock. (auth)

560 CORRELATIONS BETWEEN ^{13}C AND ΣCO_2 IN SURFACE WATERS AND ATMOSPHERIC CO_2. Kroopnick, P. (Hawaii Univ., Honolulu (USA). Hawaii Inst. of Geophysics). Earth Planet. Sci. Lett.; 22: No. 4, 397-403(Jul 1974).

^{13}C and ΣCO_2 data from the North and South Atlantic, the Antarctic, and the North and South Pacific are given. The $\delta\ ^{13}C$ of the ΣCO_2 in the deep water (~3000m) decreases from 1.7‰ in the North Atlantic to −0.10‰ in the North Pacific. This change is attributed to the addition of about 158 μmoles of CO_2 per kg of seawater. The in-situ oxidation of organic matter for 83% of this increase in ΣCO_2, while the remainder is attributed to dissolution of calcium carbonate. The $\delta\ ^{13}C$ of the dissolved CO_2 in mid-latitude surface water samples is controlled by a quasi-steady-state equilibrium with atmosphere CO_2 at a mean temperature of 16°C. The $\delta\ ^{13}C$ and ΣCO_2 values of Antarctic surface water samples suggest that these waters are derived from a mixture of North Atlantic deep water and equilibrated surface water. (auth)

561 PETROPHYSICAL AND RADIOGEOCHEMICAL BASES FOR THE SEARCH OF TIN DEPOSITS. Romanovskii, N. P.; Pavlov, G. A.; Ivanov, G. M.; Gaponov, A. P. (Far Eastern Geological Inst., Vladivostok, USSR). Izv. Vyssh. Ucheb. Zaved., Geol. Razved.; No. 5, 72-75(May 1974). (In Russian).

The magnetic susceptibility, polarizability and ^{40}K activity distribution in minerals were considered in evaluating the prospects for discovering tin deposits. It is concluded that the formation of tin deposits was accompanied by potassium–silicon metasomatosis and sulfidization of surrounding minerals with simultaneous replacement of primary magnetite by paramagnetic minerals. In most cases a correlation is noted between the richness of the tin deposit and the degree of metasomatosis in the sourrounding ore (sulfides, potassium and replacement of magnetite). The metasomatic processes lead to a regular change in the physical characteristics of surrounding minerals (a decrease in magnetizability with a simultaneous increase in polarizability and with a characteristic behavior in the potassium component of the natural radioactivity). These changes can be recorded by magnitosurveying, electrical surveying and by gamma spectroscopy. Areas where potential tin deposits may be found are delineated. (SJR).

562 CARBON-14 CALIBRATION BETWEEN THE UNIVERSITY OF WASHINGTON AND THE UNIVERSITY OF MIAMI GEOSECS LABORATORIES. Stuiver, M.; Robinson, S. W. (Washington Univ., Seattle (USA)); Oestlund, H. C.; Dorsey, H. G. (Miami Univ., Fla. (USA). Rosenstiel School of Marine and Atmospheric Sciences). Earth Planet. Sci. Lett.; 23: No. 1, 65-68(Aug 1974).

Cross-checks between the Washington and Miami Geosecs radiocarbon laboratories verify that results on identical samples measured at the two laboratories agree with the stated accuracy of each laboratory which is ±4‰ in $\Delta^{14}C$. (auth)

Site Surveys

Refer also to abstracts 494, 1292, and 2648.

563 (BNWL-1717) METHODS FOR ESTIMATING TRANSPORT MODEL PARAMETERS FOR REGIONAL GROUNDWATER SYSTEMS. Ahlstrom, S. W.; Serne, R. J.; Routson, R. C.; Cearlock, D. B. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1974. Contract AT(45-1)-2130. 26p. Dep. NTIS $4.00.

For Atlantic Richfield Hanford Co., Richland, WA.

The measurement of dispersion and sorption coefficients to the degree of detail required by a calculated transmissivity (or permeability) for the unconfined aquifer beneath the Hanford Reservation would be extremely expensive and time-consuming, if not impossible. As an alternative, methodologies were developed for estimating dispersion and sorption coefficients from correlations with characteristic soil properties. Preliminary correlations are proposed and contour maps of dispersion and sorption coefficients for the Hanford aquifer as determined from these correlations are presented. (auth)

Thermal Effluents

Refer also to abstracts 417 and 2594.

564 (CONF-740944-1) PHYSIOLOGICAL CONSIDERATIONS OF FUTURE THERMAL ADDITIONS FOR AQUATIC LIFE. Coutant, C. C. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 43p. Dep. NTIS $5.25.

From world conference on toward a plan of actions for mankind: needs and resources–methods of prevision; Paris, France (9 Sep 1974).

Some of the known physiological responses of aquatic organisms, especially fish, to temperature and temperature changes are summarized. These responses can provide a basis for future actions regarding thermal effluents in three areas: providing suitable water quality in natural environments to sustain populations of desirable wild species; developing multiple-use power plant cooling reservoirs that can provide intensive fishing for warm-water species; and intensifying food production through productive use of power plant waste heat for aquaculture. Particularly important are those physiological measures which define the optimum and limiting conditions for survival, reproduction, growth and development. (auth)

565 (NTIS-WIN-74-052) THERMAL POLLUTION. A Bibliography with Abstracts. Report for 1964–May 1974. Lehmann, E. J. (National Technical Information Service, Springfield, Va. (USA)). Jul 1974. 316p. (COM-74-11139). NTIS $20.00.

This bibliography contains 307 selected abstracts of research reports retrieved using the NTIS on-line search system NTISEARCH. The cited reports have been divided into three topics: control techniques, biological effects, and hydrology. The first section covers all phases of thermal pollution control including costs, techniques, and feasibility. The biological studies include all aspects of the effects of heated effluents on fish, microorganisms, and plants. This involves the effects on such things as growth, the ecology, metabolism, and heat tolerance. The third section concerns the hydrology and hydrodynamics of heated effluents, primarily their modeling. Such studies cover mixing, diffusion, heat transfer, and flow. (GRA)

566 EXPERIMENTAL ANALYSIS OF SUBSURFACE HEATING AND IRRIGATION ON THE TEMPERATURE AND WATER CONTENT OF SOILS. Sepaskhah, A. R. Corvallis, OR; Oregon State Univ. (1974). 168p. University Microfilms Order No. 74-23,459.

Thesis (Ph. D.).

Multiple use of waste heat from power plants may become an important consideration in the development, siting, and certification of these plants. A multiple use system of components that can beneficially utilize waste heat may include home heating and cooling, greenhouses, animal enclosures, open basins for single cell protein production and fish farming, and open field soil warming. A subsurface irrigation-soil warming system utilizing waste heat was analyzed. Thermal power plant condenser cooling water pumped through buried porous pipes was considered as a heat and water source for soil heating and subsurface irrigation. Energy is transferred from the heat source to the surrounding soil, warming it above its natural temperature. In addition, water seeping from the porous pipe prevents drying around the heat source and supplies the plant roots throughout the soil profile while avoiding the large evaporation losses at the soil surface associated with surface irrigation methods. Soil was packed in containers 48 cm deep, 40 cm wide, and 4 cm thick. A heat source consisting of a copper covered electrical resistance wire was placed against one side of the box at a depth of 32 cm. A water source consisting of a porous tube was placed 2 cm above the heat source. A series of experiments was conducted with heat source temperatures of 29, 36, and 44°C, and surface heat load cycles with maxima of 0, 13, 52, and 117 W. Temperature distributions throughout the soil profile and rates of energy dissipation were measured. Apparent thermal conductivities of Quincy, Cloquato, and Chehalis soils as a function of water content were measured at 25 and 45°C by the heat probe method. The soil apparent thermal conductivity was also computed from a theoretical model based on its mineral composition, porosity, water content, and the thermal conductivity of the individual components. Soil temperature distributions were calculated using theoretical models presented in the literature. Predicted and measured isotherms showed good agreement. Energy dissipation rates as a function of soil thermal conductivity, temperature differences between heat source and soil surface, and depth and spacing of heat source were obtained. They were in agreement with those calculated from theoretical considerations. The total land area required to dissipate the waste energy from a 1000 MWe power plant operating with 34% efficiency was calculated for each of the three soils used in the experiments. Economical and technical considerations for the installation of subsurface heating and irrigation systems require flat land close to the electrical power plant. Large areas of flat land are not always present. The water application rates ranged from 1.50 mm/day for Chehalis soil with a heat source temperature of 29°C in combination with the lowest surface heat load to 6.0 mm/day for Quincy soil with a heat source temperature of 44°C in combination with the highest surface heat load. These rates were adequate to prevent drying around the heat sources and supply the water needs of an actively growing crop. The effective use of this system depends on the development of suitable tubing to conduct and discharge water which could be used without clogging of the pores through which water seeps into the ground. The proposed soil warming and irrigation system does not appear to be an

attractive alternative power plant cooling system. The system holds promise however as an economically attractive management system for the production of high value crops. (Diss. Abstr. Inc., B)

567 THERMAL REQUIREMENTS OF THE TRICOPTERAN NYMPH, HYDROPSYCHE, FROM THE DELAWARE RIVER. Sage, L. E. Bethlehem, PA; Lehigh Univ. (1974). 221p. University Microfilms Order No. 74-21,438.

Thesis (Ph. D.).

The biota of the Delaware River is subjected to high natural temperatures in the summer, when the river is at minimum flow. This study was designed to evaluate the effects of the addition of waste heat on the dominant macroinvertebrate, the caddisfly, Hydropsyche, in the Martin's Creek reach of the Delaware River. Two stations were established; one at a riffle area 4000 feet downstream from the discharge canal of the Martin's Creek Steam Electric Station ($\Delta t = 2-4°C$) and one at a riffle area immediately upstream of the discharge canal. Metabolic activity as measured by oxygen consumption was temperature-dependent. The rate of consumption increased as a step function as the temperature was elevated. Plateaus appeared between 5 and 15°C and again between 20 and 30°C, between which are ranges of increased oxygen consumption. Beyond 32°C, oxygen consumption is abruptly altered by either a sharp increase or sharp decrease. No statistical significance could be derived from the respiration data as a function of temperature for these two Hydropsyche populations. The respiration data indicated that there was no acclimation response to reduced oxygen concentrations. Oxygen consumption of Hydropsyche indicated a metabolic threshold concentration at a dissolved oxygen concentration of 5 mg/l. Throughout the study an inverse relationship existed between the size of the specimen and the consumption per unit weight. Using autoradiographic techniques, the gonads were the most temperature-sensitive tissue studied, with metabolic activity decreasing at temperatures above 25°C. The nervous tissue was only slightly more sensitive to elevated temperatures than other tissue types, with a maximum tolerance temperature occurring at approximately 30°C. Permeability of the integument appeared to be altered at higher temperatures resulting in massive infusion of media. Population differences between the above and below effluent stations were detected in metabolic responses to reduced oxygen concentrations and to gonadal tissue activity responses to elevated temperature. Therefore, some evidence exists for genetic differences resulting from prolonged population exposure to elevated temperatures between the two stations. (Diss. Abstr. Int., B)

Chemical Effluents

Refer also to abstracts 113, 417, 1299, and 1300.

568 (IAEA–163, pp 114-116) STUDIES ON SOLUBILITY, GLASS-ADSORPTION, EXTRACTION AND EVAPORATION OF DDT USING ^{36}Cl-DDT. Duursma, E. K.; Vas, D.; Marchand, M. Jun 1974.

The analysis of seawater for pesticides is a difficult analytical problem. In order to investigate the behaviour of one such compound, DDT, a series of experiments was designed using ^{36}Cl-DDT to determine DDT solubility in sea water, its adsorption to walls of glass vessels, the reproducibility of DDT extraction from sea water by organic solvents, and its volatility when brought to dryness from solution. Preliminary results are reported. (CH)

569 (UCRL-51660) DEVELOPMENT OF AN AIR POLLUTION MODEL FOR THE SAN FRANCISCO BAY AREA. Third Semiannual Report to the National Science Foundation. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Sep 1974. Contract W-7405-eng-48. 9p. Dep. NTIS $4.00.

Progress is reported in developing and validating a regional air pollution model which can be applied to the air quality problems facing the San Francisco Bay Area. The various activities were proceeding on schedule. Aircraft Flight Data from the 1973 sampling flights have been manually reduced and prepared for entry into the data bank. Data from 1974 flights should become available by fall, 1974, at which time extensive model validation will begin. Development of the various submodels is on schedule and increasing effort is now being expended to develop graphical display of model results. Stationary source emission data are entered into the data bank and updated as new data become available. Efforts to develop a comprehensive mobile source emission inventory continue and the inventory should be available to the model by October 1974. Plans are complete to conduct fluorescent particle tracer experiments to investigate transport between the inversion layer and the mixing layer. Initial experiments are planned to start in August, 1974. A first set of reduced photochemical reactions has been selected and work will continue to assess assumptions and to test the sensitivity of the reactions to various parameters. The reduced set will be included in test runs of LIRAQ-2 in later summer. (auth)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstracts 717 and 718.

General Detectors and Monitors

Refer also to abstracts 634, 1027, 1042, 1045, 2169, and 2233.

570 (BMVg-FBWT-72-33) DEVELOPMENT AND USE OF A SPARK COUNTER FOR FAST EVALUATION OF SOLID STATE TRACK DETECTORS. Paretzke, H. G. (comp.). (Bundesministerium fuer Verteidigung, Bonn (F. R. Germany). Dokumentationszentrum der Bundeswehr; Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Strahlenschutz). 1972. 15p. (In German).

The density range of 0.1 to 1,000 tracks/cm^2 is of particular interest in neutron and radon dosimetry with nonphotographic solid state track detectors. For fast evaluation of thin detectors with this track density, a spark counter operating according to the principle proposed by Cross and Tommasino is most appropriate. Therefore, such a device has been developed for practical routine purposes. The apparatus differs from other spark counters mainly in that it is battery powered, versatile, easily transportable and easy to operate. With this device the influence of etching and operation parameters on the result as well as the reproducibility of the measuring method was investigated. This was done especially for Makrofol detectors irradiated in 2π-geometry with fission fragments of the U(n,f) reaction. (auth)

571 (BMVg-FBWT-72-34) INVESTIGATIONS ON THE AUTOMATIC EVALUATION OF NUCLEAR TRACK DETECTORS BY MEANS OF AN ON-LINE FLYING SPOT DEVICE. Abmayr, W. (comp.). (Bundesministerium fuer Verteidigung, Bonn (F. R. Germany). Abt. Wehrtechnik; Bundesministerium fuer Verteidigung, Bonn (F. R. Germany). Dokumentationszentrum der Bundeswehr). 1972. 22p. (In German).

For the evaluation of dielectric track detectors within the density range more than 10^3 tracks/cm^2, optical evaluation methods are appropriate. In the method described, track images are being scanned by means of a flying spot device and transmitted on-line in a digital computer. Using suitable programs different questions can be solved. The determination of the track density with regard to overlapping are studied in particular. The size distribution of track areas was determined. For the correction of overlapping, a very low dependence on threshold parameters is obtained. Measurements have been performed on α-track images, and the automatic measurement has been compared with visual counting. (auth)

572 (CONF-740935-1) RAPID DETERMINATION OF RADON DAUGHTER CONCENTRATIONS AND WORKING LEVEL WITH THE INSTANT WORKING LEVEL METER. Groer, P. G.; Keefe, D. J.; McDowell, W. P.; Selman, R. F. (Argonne National Lab., Ill. (USA)). [nd]. 24p. Dep. NTIS $4.25.

From international symposium on radiation protection in mining and milling of uranium and thorium; Bordeaux, France (9 Sep 1974).

Rn-daughter concentrations and the Working Level (WL) were measured with Instant Working Level Meters (IWLM) in an experimental uranium mine in the U. S. This instrument is fully automated and portable (dimensions: 40 cm × 35 cm × 25 cm, weight: 17 kg) and determines RaA, RaB, and RaC concentrations and the WL within five minutes. It displays these quantities digitally in the appropriate units (pCi/liter and WL) and has a range from 0.01 to 100 WL. A short description of its theory is presented. Each air sample taken and analyzed by the IWLM was also evaluated by an α-spectroscopic method. The RaA, RaB, RaC concentrations and the WL's obtained with these two methods are compared with Fisher's Sign Test. These tests show that the IWLM evaluates the Rn-daughter concentrations and the WL without bias. The instrument is therefore as accurate as the spectroscopic method used. Another test (Ansari-Bradley test) shows in addition that the IWLM-measurements exhibit the same variance as the measurements performed with the spectroscopic method. This implies, therefore, that the two methods have the same precision. The IWLM-method of Rn-daughter analysis should be used, wherever a rapid determination of Rn-daughter concentrations is needed (e.g., efficiency analysis of ventilation systems in uranium mines). (auth)

573 (CONF-740935-2) PORTABLE α COUNTER FOR URANIUM MINES WITH PRESET, UPDATED READOUT. Keefe, D. J.; McDowell, W. P.; Groer, P. G. (Argonne National Lab., Ill. (USA)). [nd]. 14p. Dep. NTIS $4.00.

From international symposium on radiation protection in mining and milling of uranium and thorium; Bordeaux, France (9 Sep 1974).

The counter described uses a Si surface-barrier detector and LED display. It is portable (dimensions: 25 cm × 11 cm × 11 cm, weight: 1.5 kg) and is powered by rechargeable Ni–Cd batteries. Three preselected times can be set on three digit switches. After the start of the counting procedure the display is updated whenever a preselected time is reached. The total α counts or RaA and RaC' counts, accumulated from the start to this particular time, are displayed. Counts accumulated between two preselected times can be obtained by subtraction. Display of counts during a fixed time interval (39 to 41 minutes after the end of sampling) is also provided to allow the use of the Kusnetz Method. This counter makes it possible to determine the Rn-daughter concentrations by several new methods. Equations relating counts to Rn-daughter concentrations are given and their precision is analyzed for 1 WL equilibrium air. It is found that these new methods are slightly more precise than the existing methods (Modified Tsivoglou and α-spectroscopic method by Martz et al.). (auth)

574 (INS-TL-124) PROPAGATION OF IMPULSES ON A RC TRANSMISSION LINE. Watanabe, S.; Husimi, K. (Tokyo Univ., Tanashi (Japan).- Inst. for Nuclear Study). 27 May 1974. 19p. NTIS (US Sales Only).

RC transmission lines are used as delay networks of the single wire proportional counter and the solid state position detector. The propagations of voltage and current impulses on the RC transmission line are analyzed in the condition that the transmission line is ideally terminated or infinitely long. (auth)

575 (NP-20204) DEVELOPMENT OF A LIQUID HELIUM POLARIMETER FOR FAST NEUTRONS AND MEASUREMENT OF NEUTRON POLARIZATION FROM THE REACTION $^{14}C(d,n)^{15}N$. Meyer-Kretschmer, G. (Hamburg Univ. (F. R. Germany). Fachbereich Physik). 7 Feb 1973. 65p. (In German). INIS.

21 figs.; 5 tabs.; with refs. With abstract. Available from the library of the Hamburg Univ.

A fast neutron polarimeter was developed, using liquid helium as an analyzer. The effectivity (the product of the effective polarization–asymmetry ratio and efficiency) is 0.3×10^{-3} for 10 MeV and 1.1×10^{-3} for 3 MeV neutrons. For the calculation of the effective polarization-asymmetry ratio, a Monte Carlo computer program was used. (GE)

576 (SZS-163) EQUIPMENT FOR INTERNAL CONTAMINATION MONITORING IN STAATLICHES AMT FUER ATOMSICHERHEIT UND STRAHLENSCHUTZ. Design of a Large Radio Shielding Installed in a Radiation Protection Laboratory. Loessner, V.; Poulheim, K. F.; Schlueter, W.; Klucke, H. (Staatliche Zentrale fuer Strahlenschutz, Berlin (German Democratic Republic)). Jul 1974. 40p. (In German). Dep. NTIS (US Sales Only) $5.00.

Equipment available in Staatliches Amt für Atomsicherheit und Strahlenschutz for internal contamination assessment is reviewed. Design and operational principles of the system components, e.g., body surface contamination monitoring, whole-body counters (including one for measuring low-energy photon emitters), exhalation analysis, physical methods of bioassay, and data sampling and processing, are described. (auth)

577 FLOW VERSUS BATCH DETECTION OF RADIOACTIVITY IN COLUMN CHROMATOGRAPHY. Sieswerda, G. B.; Poppe, H.; Huber, J. F. K. (Univ. Amsterdam). pp 16-37 of Application of Radioactive Compounds in Column Liquid Chromatography. Sieswerda, G. B. Amsterdam; Univ. Amsterdam (1974).

The precision of flow-through and batchwise counting of radioactivity are compared. The influence of the detector volume on the chromatographic resolution and the precision of counting is discussed. The dependence of the precision of the counting result on the retention time is described. Three different types of radiometric flow-through detectors have been tested with respect to the precision of the counting result. The precision of the GM flow detector is insufficient; the dynamic behaviour meets the requirements. The NaI(Tl) flow detector shows good properties concerning precision of counting as well as maintenance of chromatographic resolution. The precision in the counting result of the scintillator flow detector is sufficient in the circumstances; the contribution to peak broadening is extremely high. The influence of the detector volume on the

precision of the counting result and the chromatographic resolution has been tested. Also, the effect of the retention time on the precision is investigated. (NL)

578 OBSERVATION PROJECT OF THE ISOTOPES OF HEAVY PARTICLES IN COSMIC RAYS USING A Si(Li) dE/dx-E TELESCOPE. Nagata, K. (Tamagawa Univ., Machida, Japan). Uchusen Kenkyu, 17: No. 4, 494-503(Feb 1973). (In Japanese).

From symposium on charged particles and cosmic radiation; Hamamatsu, Japan (Dec 1971).

A telescope which is composed of a large scale dE/dx-E detector by using Si(Li) detectors was used for the measurement of heavy particles in cosmic rays. The objects of measurement of the present telescope are L-nuclei (Li, Be, B) and M-nuclei (C, N, O, F), especially ^{12}C and ^{13}C. The precise separation of nuclei having energy around 100 MeV/n and the measurement of energy spectra are intended. The detector consists of a coincidence Si(Li) detector of 50 mm $\phi \times 1$ mm, a dE/dx detector 50 mm $\phi \times 1$ mm and an E detector of 50 mm $\phi \times 15$ mm effective thickness. Particles which pass through the third detector (E detector) are removed by a plastic scintillator for non-coincident measurement. Luminescence from the fourth detector is measured by a Si photodiode. The energy regions detected by the telescope are 13 to 80 MeV/n for ^{6}Li, and 40 to 130 MeV/n for ^{16}O. This telescope was equipped on an artificial satellite. The counts of Be and C for 6 months were 500 and 4,000, respectively. The data obtained were transmitted by telemetry. The data were the output of the second detector and the third detector; triple coincidence counts of the first, second, and third detectors; non-coincident counts of the second, the third, and the Si photo diode; and the gate signals of coincident and non-coincident circuits. The atomic number, mass number and energy of particles were determined. (JA)

579 MEASUREMENT OF THE ENERGY DISTRIBUTIONS OF THE FRAGMENTS DERIVED FROM THE FISSION OF PREACTINIDE NUCLEI BY ALPHA PARTICLES, USING THE TRACK METHOD. Itkis, M. G.; Okolovich, V. N.; Pavlov, A. F.; Rus'kina, G. Ya. Sov. At. Energy (Engl. Transl.); 34: No. 2, 175-177(Feb 1973).

Translated from At. Energ. (USSR); 34: No. 2, 133-135(Feb 1973).

The successful use of dielectric track detectors for measuring the mean kinetic energies of the fragments from the fission of ^{185}Re, ^{188}Os, ^{197}Au, and ^{209}Bi by 38-MeV alpha particles is reported. (WHK)

580 SPECTROPHOTOMETRIC CHARACTERISTICS OF γ-SPECTROMETER OF HUMAN RADIATION. Belle, Yu. S.; Kovtun, A. N.; Lebedev, O. V. Med. Radiol.; 19: No. 8, 44-47 (Aug 1974). (In Russian).

The spectral characteristics of the SICH-5.1 γ spectrometer used in the measurement of the whole-body γ radiation of man were determined. The energy resolution, the background spectra, registration efficiency, and the minimum activities measurable with this spectrometer were determined. (JSR)

581 RADIATION STABILITY OF SCINTILLATING PLASTICS. Beregovenko, E. D.; Gorbachev, V. M.; Uvarov, N. A. Sov. At. Energy (Engl. Transl.); 34: No. 2, 160-161(Feb 1973).

Translated from At. Energ. (USSR); 34: No. 2, 124(Feb 1973).

The results of an experimental evaluation of changes in the light yield of polystyrene under the influence of pulsed x-radiation are presented. The radiation source was a pulsed MIG-5000 x-ray tube. In the case of a pulse duration of 1/μsec and an average quantum energy ~0.7 MeV, the maximum dose in the pulse was 2×10^4 R. The dose was measured with glass dosimeters. The relative losses of the light yield of the scintillator for various time intervals after irradiation, T_{meas}, was determined by two methods: (1) for $T_{meas} \approx (2 \text{ to } 12) \times 10^{-6}$ sec according to the change in the transparency of the scintillator for the light radiation of a flash lamp of the IFK type, measured with a photocell; and (2) for $T_{meas} \geq 1$ min, the investigated PS was set up on a photomultiplier and a determination was made of the relative change in the value of the exit curve of the FEU during irradiation of the PS with γ quanta of a ^{60}Co source before and after the pulse of x-radiation. Results are given. (WHK)

582 DETECTOR CHARACTERISTICS OF A SILICON CARBIDE DETECTOR PREPARED BY THE DIFFUSION OF BERYLLIUM. Tikhomirova, V. A.; Fedoseeva, O. P.; Kholuyarov, G. F. Sov. At. Energy (Engl. Transl.); 34: No. 2, 158-159 (Feb 1973).

Translated from At. Energ. (USSR); 34: No. 2, 122-124(Feb 1973).

SiC detectors were made by diffusing beryllium which has a diffusion coefficient in SiC of two to three times that of boron or aluminum. The depth of the p-n transistor region is 10 to 20μ; this was achieved by diffusing beryllium into n-SiC at a temperature of 1600 to 1700°C for 20 to 30 min. The ohmic contact to the n side was a thermoresistant alloy of tungsten with nickel, imbedded in vacuo at 1600°C, and the contact to the p side (detector window) was metallic chromium, diffused by vacuum sputtering to a thickness of 400 to 500 Å. The energy resolution of the detector was studied using alpha particles from ^{235}U (4.8 MeV) and fission fragments obtained in a reactor by irradiation of ^{235}U (90% enriched) under a 6 mg/cm^2 cover. (WHK)

583 EVALUATION OF SILICON SEMICONDUCTOR DETECTOR EFFICIENCY FOR 0.661 AND 1.25 MeV GAMMA RAYS. Gol'din, M. L.; Pater-Razumovskii, K. R.; Virnik, F. V. Sov. At. Energy (Engl. Transl.); 34: No. 2, 156-157(Feb 1973).

Translated from At. Energ. (USSR); 34: No. 2, 121-122(Feb 1973).

The dependence of the counting efficiency of silicon p-i-n detectors on detection threshold and sensitive layer thickness was studied experimentally and theoretically. (WHK)

584 RADIATION-MEASURING INSTRUMENT WITH SURFACES SHIELDED AGAINST CONTAMINATION. Van Der Koogh, G.; Bernards, A. P. (to Reactor Centrum Nederland). US Patent 3,826,918. 30 Jul 1974. Priority date 10 Sep 1970, Netherlands. 6p.

Instruments for measurement of electromagnetic and/or corpuscular radiation in fluid media are likely to be contaminated by deposition of material from the fluid. The contamination of detectors, radiation sources or other vital surfaces in radiation measurement instruments is prevented by placing a porous window before the surfaces threatened by contamination and flowing a purging fluid through the porous window. (Official Gazette)

585 APPLICATION OF SOLID SCINTILLATORS IN HIGH PRESSURE RADIO COLUMN CHROMATOGRAPHY. Sieswerda, G. B.; Polak, H. L. (Univ. Amsterdam). pp 5-15 of Application of Radioactive Compounds in Column Liquid Chromatography. Sieswerda, G. B. Amsterdam; Univ. Amsterdam (1974).

From symposium on Liquid Scintillation Counting; Brighton, Eng. (13 Sep 1971).

The author designed a chromatographic system that combines the advantages of the continuous and discontinuous counting methods. In this system the flow cell serves as a level detector and steers a fraction collector. In other words as soon as the background rises to an adjustable level the effluent is collected until the background returns to its original level. The collected fraction can then be prepared for discontinuous measurement. The construction of the apparatus is described and static efficiencies of labelled amino acids experiments are tabulated. The peak tracer method which is applied here is discussed. (NL)

586 NUCLEAR-RADIATION DETECTORS BASED ON HIGH-PURITY GERMANIUM. Aver'yanova, V. P.; Ginzburg, M. I.; Strokan, N. B.; Subashieva, V. P.; Tisnek, N. I. Sov. At. Energy (Engl. Transl.); 34: No. 6, 591-593(Jun 1973).

Translated from At. Energ. (USSR); 34: No. 6, 483-485(Jun 1973).

The fabrication and characterization of high-purity Ge detectors are discussed. The energy resolutions for α, β, and γ detection are given. (WHK)

587 RADIATION DETECTOR USING ELECTRO-OPTICS. Kerlman, I. B.; Strash, A.; Kastner, J. (to United States Atomic Energy Commission). US Patent 3,831,028. 20 Aug 1974. Filed date 26 Jun 1973. 4p.

The radiation detector consists of a cell containing a polar liquid positioned between two crossed polarizers. The light beam is directed through the cell to a detector and the polarizers are arranged for extinction of the light. Local birefringence developed by the ionizing radiation permits light to be transmitted to the light detector. (Official Gazette)

588 APPARATUS FOR MEASURING RADIOACTIVITY IN THE HUMAN EYE. Knoll, G. F. (to United States Atomic Energy Commission). US Patent 3,827,427. 6 Aug 1974. Filed date 8 Jan 1973. 8p.

Measurement of radioactivity in the human eye is facilitated by affixing an eye cup to a radiation detector to maintain a precisely repeatable position of the detecting element with respect to the

eye. This apparatus is particularly useful in the diagnosis of ocular melanoma in patients who have ingested a radioactive chemical that is concentrated in an ocular melanoma. Such precisely repeatable positioning of the radiation detector allows use of smaller doses of the radioactive tracer, thus minimizing the radiation hazard to the patient. (Official Gazette)

589 LONG-DISTANCE TRANSMISSION OF ANALOG GAMMA CAMERA SIGNALS. Dowsett, D. J.; Roberts, K. (University Coll. Hospital, London). J. Nucl. Med.; 15: No. 10, 896-899(Oct 1974).

A system for transmitting γ camera analog coordinate information over long distances to a computer center using coaxial cable links is described. The methods used for minimizing signal loss and reducing noise artifacts are outlined together with a description of the interface, which receives and corrects the transmitted signals prior to digitizing. (auth)

590 RADIATION EFFECTS IN CESIUM IODIDE SINGLE CRYSTALS ACTIVATED BY THALLIUM UNDER GAMMA RADIATION. Berezin, I. A.; Gorbachev, V. M.; Kuzyanov, V. V.; Sten'gach, I. N.; Uvarov, N. A. Sov. At. Energy (Engl. Transl.); 35: No. 5, 1055-1058(Nov 1973).

Translated from At. Energ. (USSR); 35: No. 5, 364-366(Nov 1973).

The luminescence spectra and light yield of CsI(Tl) crystals as functions of the γ dose up to 10 Mrad, the recovery of the scintillation properties of single crystals during storage, the variation of the degree of radiation damage to the crystals as a function of thallium content, and the influence of prior heat treatment on increased radiation stability in a scintillator were studied. (WHK)

591 INVESTIGATION OF THE CHARACTERISTICS OF LAVSAN TRACK DETECTORS. Koroleva, V. P.; Samovarov, V. S.; Chernov, L. A. Sov. At. Energy (Engl. Transl.); 35: No. 5, 1044-1046(Nov 1973).

Translated from At. Energ. (USSR); 35: No. 5, 357-359(Nov 1973).

The detection efficiency and energy threshold of Lavsan track detectors for fission fragment detection were determined; and fission track dimensions as a function of etching time, chemical solvent, chemical solvent concentration, and chemical solvent temperature were measured. (WHK)

592 SOUND DETECTOR OF X RAY AND γ RADIATION. Lapchuk, T. V.; Nosenko, V. A.; Chernyaev, P. A.; Checheneva, I. V. Med. Radiol.; 19: No. 7, 77-82(Jul 1974). (In Russian).

The results of experimental work aimed at creating the sound detector of photon radiation with the range of energy from 10 to 1250 keV (1.5 to 200 photon joules), the size of the ionizing chamber being 0.2 cm^3 are presented. It underlines the peculiarities of the choice of the material for the electrode holder of a small size chamber. Energy characteristics of the detectors with different material of external and internal electrodes are shown. It was experimentally shown that the measurement error at the expense of dependence of sensitivity of a small size chamber upon the energy of the registered radiation in a wide range of energies could be decreased to 10 percent. It presents the data on anisotropism of detectors at energies of 20, 65, and 1250 keV within $\pm 135°$ from the longitudinal axis of the detector. (auth)

593 BACKGROUND OF THE PHILIPS G. M. COUNTERS 18,515 AND 18,516 WITH AND WITHOUT ANTICOINCIDENCE. Sirbu, M. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 25: No. 5, 629-632(1973). (In Rumanian).

A table of the background of GM counters in three cases i.e., without screen, with 50 mm Pb, and with 150 mm Cu is presented. For every case the background with and without anticoincidence was measured. The best result obtained with the 18,516 counter in anticoincidence with the 18,518 counter is 1.3 ± 0.10 p/m for the copper screen. (auth)

594 STRONG GEOMETRY INSTALLATION OF MOBILE TYPE, FOR BETA-RAY MEASUREMENTS. Sirbu, M. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 26: No. 3, 381-383(1973). (In Rumanian).

A strong geometry installation for beta-ray measurements that uses beta GM counters made in Romania is described. The advantage of this installation is that it may be used without connection to the national ac network. (auth)

Radiation Dosimeters

Refer also to abstract 724.

595 (AD-776951) INVESTIGATIONS OF POSSIBLE SYNERGISTIC EFFECTS OF NEUTRONS AND PHOTONS IN SELECTED DOSIMETRIC MATERIALS. Jacobson, J. R.; Rodgers, M. P. (Ballistic Research Labs., Aberdeen Proving Ground, Md. (USA)). Mar 1974. 41p. (BRL-1704). NTIS $3.25.

An experiment was conducted to investigate the possible existence of a synergistic response in several different dosimetric materials when they are exposed to fast neutrons and gamma rays. Gamma ray exposure data obtained on various nuclear weapon tests indicated that the possibility exists that these materials did not respond in an additive manner when exposed to a radiation environment containing both neutrons and photons (gamma rays). The experimental procedure consisted of exposing the dosimeters individually to neutron and gamma rays as well as to a combined neutron and gamma ray environment. The investigation revealed that three of four types of gamma ray exposure dosimeters routinely employed do not respond in a strictly additive manner when exposed to mixed radiation environments. Based on the accepted definition of the word synergism, only LiF thermoluminescent dosimeters (TLD) exhibited a synergistic effect. That is the combined neutron and gamma ray response was greater than the sum of the individual responses for this particular dosimeter. (auth)

596 (AD-777517) NEUTRON RESPONSE MEASUREMENTS FOR VARIOUS PASSIVE GAMMA DOSIMETERS. Jacobson, J. R. (Ballistic Research Labs., Aberdeen Proving Ground, Md. (USA)). Mar 1974. 28p. NTIS $3.25.

Neutron response information for six different gamma ray dosimeters was obtained spanning the energy region from 0.5 to 14.1 MeV. The dosimeters used in the investigation included two types of CaF_2:Mn thermoluminescent dosimeters (TLD), two different forms of LiF TLD employing enriched isotopic concentrations of ^6Li and ^7Li, and silver-activated metaphosphate glass (high Z composition). Where comparisons with previously published data could be made, the results of this investigation are in good agreement. The ^7LiF ribbon dosimeter exhibited a response 10 to 30 times larger than that observed for the other LiF TLDS studied. This effect is unexplained at this time; however, due to its obvious significance, it is felt that a more detailed investigation is warranted. The differences in the neutron responses of the other dosimeters can also be a significant factor when making a gamma ray exposure measurement in a mixed radiation environment. The experimenter, therefore, must consider the neutron energy spectrum and the neutron-to-gamma ratio when selecting a dosimeter to use in a specified environment. (auth)

597 (CONF-740940-2) SOME ADVANCES IN SOLID-STATE FAST NEUTRON DOSIMETRY. Becker, K. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 20p. Dep. NTIS $4.00.

From 3rd international congress on photosynthesis; Rehovot, Israel (2 Sep 1974).

Progress which has been made at ORNL in solid-state fast neutron dosimetry since the last review on this subject was presented in 1972 is summarized with emphasis on the following topics: (1) further studies on the directional and energy response characteristics of TSEE detectors based on ceramic BeO covered with hydrogenous radiators, and on a new method for extending the dynamic range of gas-flow TSEE readers by two orders of magnitude; (2) experiments with highly dispersed and sensitive TLD phosphors permanently embedded in high-melting organic radiators such as p-sexiphenyl; (3) investigations on the automatic spark counting of neutron-induced recoil particle tracks in thin polymer foils after extended etching; and (4) studies concerning the feasibility of intercomparisons by mail of neutron sources with an accuracy of better than $\pm 5\%$ in the ~50 to 500 rad range by using fission fragment track etching. The relative merits and disadvantages of the various methods, for personnel monitoring and other applications, are discussed briefly, and a few other promising approaches are mentioned. (auth)

598 (JAERI-M-5608) CALIBRATION OF THE CTA FILM DOSIMETER FOR ^{60}Co GAMMA-RAYS AND ELECTRON BEAM. Tanaka, R.; Yotumoto, K.; Tajima, S.; Kawai, M.; Mizuhashi, K. (Japan Atomic Energy Research Inst., Tokyo). Mar 1974. 32p. (In Japanese). NTIS (US Sales Only).

The CTA (cellulose triacetate) dosimeter has been calibrated for both ^{60}Co gamma-rays and 1.5 MeV electron beam in the megarad region. The calibration for gamma-rays is by two methods, i.e., with an ionization chamber or a Fricke dosimeter. Agreement between the two methods is good within experiment uncertainty. For electron beams the calibration is by relative depth dose curves in CTA normalized by the energy fluence determined by two methods, i.e., beam current measurement or calorimetry. The results are also in good agreement. The calibration constant

differs between gamma-rays and an electron beam, which indicates that the response of a CTA dosimeter is dependent on the dose rate. Corrections for the gamma-ray exposure rate and the electron beam intensity and the uncertainty in their values are also discussed. (auth)

599 (KFK-2032) STUDY OF THE LATENT FADING OF NTA FILM AND TRACK ETCHING DETECTORS AT VARIOUS TEMPERATURES AND HUMIDITIES. Sayed, A. M.; Piesch, E. (Kernforschungszentrum Karlsruhe (F. R. Germany). Abt. Strahlenschutz und Sicherheit). Aug 1974. 63p. Dep. NTIS (U. S. Sales Only) $6.25.

After exposure to ^{252}Cf fission neutrons the latent fading of nuclear track detectors was investigated for storage periods up to 30 days at temperatures of 5°C, 25°C, and 50°C and relative air humidities of 0%, 53%, and 97%. Fading results are discussed for Kodak NTA films in the original wrapping and in an aluminium-plastic sealing, cellulose acetate and Makrofol E for the detection of neutron induced recoils and α-particles, and Makrofol E and KG in contact with a thorium foil for the detection of fission fragments. NTA film and cellulose acetate show a high fading up to more than 50% after a period of 3 weeks, but no tracks at higher temperature and humidity. Under the extreme conditions the fading of Makrofol was found to be 23% after a 3 weeks period, but no fading was found under laboratory conditions for a period of 2.5 years. (auth)

600 (UCRL-75593) STUDIES OF CALORIMETER PERFORMANCE AT LAWRENCE LIVERMORE LABORATORY. Ackerman, F. J.; Tsugawa, R. T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Jun 1974. 18p. (CONF-740668-1). Dep. NTIS $4.00.

From Mound gas properties conference; Miamisburg, Ohio, USA (10 Jun 1974).

Three radiometric samples were used to study the reproducibility and bias of measurements made with two calorimeters. Both calorimeters are commonly used for tritium assay work. One calorimeter is a twin-thermopile type with a capacity of 0.2 to 20 W; the other is a single-tube, twin-resistance-bridge type with a capacity of 2 to 30 W. Three standards were studied: 1.5, 9.3, and 20.4 W. The smaller unit was found to have a bias of +0.28% a precision of ±0.12% (2σ) for 24 measurements. The larger unit had a bias of −0.14% and a precision of ±0.64% for 18 measurements. (auth)

601 EVALUATION OF NEUTRON SENSITIVITY FOR A PERSONNEL DOSIMETER USING TYPE-K NUCLEAR EMULSION. Gelev, M. G.; Komochkov, M. M.; Mishev, I. T.; Salatskaya, M. I. (Inst. of Physics, Sofia). Sov. At. Energy (Engl. Transl.); 34: No. 2, 152-155(Feb 1973).

Translated from At. Energ. (USSR); 34: No. 2, 118-121(Feb 1973).

During the past ten years at JINR, Type-K nuclear emulsions 20μ thick deposited on triacetate film and enclosed in a correcting holder have been used to measure the individual neutron doses received by staff members when working near radiation sources. This method has been verified for the measurement of the dose from fast neutrons ($0.5 \leq E < 15$ MeV); it allows dose measurement in the range 0.02 to 15 rem. However, in order to determine the total personnel dose from neutrons when working outside the thick shielding of reactors and accelerators, it is insufficient to know the fast neutron dose alone. The contribution from thermal neutrons ($E < 0.4$ eV) in such cases to the total dose may amount to 10%, and to 60% or more for intermediate neutrons (0.4 eV $< E <$ 0.5 MeV). Consequently, personnel monitoring dosimeters must record with sufficient accuracy the dose not only from fast neutrons but also the dose from thermal and intermediate neutrons. A calculated estimate of the sensitivity of a personnel neutron dosimeter using Type-K emulsion to thermal and intermediate neutrons is presented, and an experimental verification of the sensitivity of such a dosimeter to thermal neutrons is given. (WHK)

602 LOW-BACKGROUND GAMMA SPECTROMETER. Surkov, Yu. A.; Sobornov, O. P. Sov. At. Energy (Engl. Transl.); 34: No. 2, 162-164(Feb 1973).

Translated from At. Energ. (USSR); 34: No. 2, 125-127(Feb 1973).

The scintillation gamma spectrometer is intended for studying low contents of radioactive isotopes in samples of various material compositions. The background of the apparatus is reduced by means of a massive lead, steel, and copper screen (total thickness 160 mm) and by a special choice of construction materials and active shielding using a plastic scintillator. The block diagram of the apparatus is shown. The shield detector has the shape of a cylinder 400 × 410 mm in size with a well (dimensions ϕ 120 × 270 mm) perpendicular to the axis. At the conical ends it is provided with two FEU-49 photomultipliers. The scintillator is covered with a white titanium enamel. In the well is a stainless steel vessel with sides 0.3 mm thick containing the analyzing detector, which is capable of being moved horizontally and vertically by means of a special mechanism, so enabling the samples and crystals to be replaced. In the working position the detector lies in the center of the plastic scintillator. The sides of the shielding structure are set rails and may be moved by means of horizontal displacement mechanisms allowing access to the structural elements of the active shielding. When studying samples 5 to 50 cm^3 in size the main analyzing detector is an NaI/Tl crystal ϕ 100 × 100 mm in size with a well (size ϕ 33 × 60 mm). The resolution of this detector with respect to ^{137}Cs (using an FEU-52M) is 9.0%. The crystal is set in a container made of oxygen-free copper with a quartz light-guide window 18 mm thick. In measuring samples up to 500 cm^3 a scintillation unit with an NaI/Tl crystal ϕ 76 × 76 mm in size is employed; this has a resolution of 8.4%. In this case the specimen is placed in a special container around the crystal in the form of a layer 12 mm thick. The apparatus is situated below ground level. A concrete cover some 300 g/cm^2 thick placed above the apparatus further reduces the contribution of cosmic rays to the background spectrum. In order to reduce the contribution from emanations, a blower system is incorporated, and the analyzing detector is automatically made airtight in the working position. As a result of the shielding, the background level in the range 150 to 3600 keV is reduced by a factor of 80 to 100. The limiting reduction is governed by the intrinsic radioactivity. (WHK)

603 NEW DEVELOPMENTS IN PASSIVE RADIATION DOSIMETRY: RADIATION-INDUCED THERMALLY ACTIVATED CURRENTS. Moran, P. R.; Podgorsak, E. B.; Fuller, G. E.; Fullerton, G. D. (Univ. of Wisconsin, Madison). Med. Phys.; 1: No. 3, 155-160(1974).

Radiation-induced thermally activated currents (RITAC) in ultrahigh-purity dielectrics provide a radiation dosimetry technique which is practical for applications at room temperature and is much more sensitive than other more well known, solid state dosimetry effects. The essential requirement for producing high-radiation-sensitivity RITAC readout, either in polarization or conductance modes of operation, is selective purification of the dosimetry material. Simple methods exist for monitoring the active impurity levels for fabrication of highly sensitive reproducible RITAC effect devices. (auth)

604 DOZIMETRIYA ELEKTRONNOGO IZLUCHENIYA. (Dosimetry of Electron Radiation). Baranov, V. F. Moscow; Atomizdat (1974). 232p.

This is the first book generalizing the information available on differential and integral characteristics of electron and beta radiation fluxes passing through a layer of substance of finite thickness or being propagated in a semi-infinite medium. Consideration is given to the main process for the interaction of electrons having an energy <10 MeV with matter. Results are presented on Monte Carlo calculations of the main characteristics of fields of electron radiation scattered in light media. Calculated values are compared with experimental data. The main methods are presented for the dosimetry of electron radiation having a continuous spectrum. The formation of a field of bremsstrahlung radiation is considered during complete and partial absorption of electron and beta radiation. (25 tables, 71 figures, 208 references) (SJR)

605 DETERMINATION OF TL GLOW PEAKS AT HIGH TEMPERATURES USING UV PHOTOSTIMULATION. Konschak, K. (Univ., Dresden). Radiochem. Radioanal. Lett.; 19: No. 1, 1–9 (13 Oct 1974). (In German).

Short-time annealing in air at temperatures from 450 to 900°C taking place between normal TL-readout and uv-photostimulation gave results which made possible the calculation of the high-temperature peak. The high-temperature peak provides the electrons for UV-photostimulation. For natural CaF_2 this peak is located at 635°C. The total error is 10%. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 1994, 1997, 2114, and 2322.

606 (AD-778366) PASSIVE NEUTRON DETECTOR WITH ENERGY RESOLUTION BETWEEN 3 AND 20 MeV. Final Report. Frank, A. L.; Benton, E. V.; Albergotti, J. C. (San Francisco Univ., Calif. (USA). Dept. of Physics). 25 Mar 1974. 73p. NTIS $3.75.

A detector has been developed for the spectral measurement of neutrons over a fluence range of approximately 1.5×10^8 to

5×10^{11} neutrons/cm^2 and in the energy range between 3 and 20 MeV. The detector consists of a radiator whose nuclei are elastically scattered by neutrons, a degrader which reduces the energies of recoil nuclei transmitted through it, and a recorder capable of registering the tracks of energetic recoil nuclei. The detector offers the advantages of compactness, stable sensitivity, permanence of recorded data, and insensitivity to background radiations. There are no flux effects present or limitations due to reaction half-life. Computer programs are provided for calculating track densities from detector measurements (FLUENZ), for determining the angular response of the detector (SLANT), and for the unfolding of neutron spectra (HENDU). (auth)

607 (BMVg-FBWT-72-4) COINCIDENCE SPECTROMETER FOR FAST NEUTRONS. Schneider, H.; Richter, B.; May, R.; Kloes, H. (comps.). (Bundesministerium fuer Verteidigung, Bonn (F. R. Germany). Dokumentationszentrum der Bundeswehr; Giessen Univ. (F. R. Germany). Strahlenzentrum). 1972. 19p. (In German).

A coincidence spectrometer for fast neutrons is described. The energy is measured by proton-recoil in a stilbene crystal. A coincidence circuit with a ^{6}Li-glass-scintillator detects those neutrons which are stopped in the stilbene crystal. The energies of neutrons from several (d,n) reactions are measured in the range 0.8 to 14 MeV. (auth)

608 (GSF-S-164) DETERMINATION OF THE TRANSFER MATRIX OF A SCINTILLATION SPECTROMETER FOR NEUTRONS AND UNFOLDING OF NEUTRON SPECTRA. Eckl, W. (Technische Univ. Muenchen (F. R. Germany). Fakultaet fuer Maschinenwesen und Elektrotechnik; Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Strahlenschutz). [nd]. 70p. (In German).

For a NE 213 scintillator, transfer functions for neutrons in the energy range of 0.1 to 14 MeV were calculated using a Monte Carlo method. The results are in good agreement with measured transfer functions within the statistical error limits after correction of the effects occurring during the generation of monoenergetic neutrons. From the calculated transfer functions the proper transfer matrices are developed for two different measurement ranges, assuming an ideal resolving power. Using these transfer matrices, the measured pulse height distributions are unfolded for various neutron sources. The final neutron spectrum was obtained after a partial correction by the finite resolution of the apparatus. The neutron spectra are determined for the energy range of 0.5 to 11 MeV. They show the following deviations from known measured results: (1) a higher low-energy portion; (2) a more distinct structure; and (3) a lower plotable neutron energy of about 0.5 MeV. An extension of the measurement range down to low neutron energies can only be obtained by improved electronics. From the measured data it can be concluded that the unfolding of neutron spectra under the assumption of a simple n-p scattering can be used to determine the components of a neutron radiation (radiation protection). For a quantitative statement, however, transfer functions have to be used which take into account all possible reactions in the scintillator. (auth)

609 (IAEA-R-536-F) COMPARISON OF FAST-NEUTRON SPECTRA FROM THRESHOLD-FOIL ACTIVATION DATA WITH SPECTRA FROM SCINTILLATION AND SANDWICH SEMICONDUCTOR SPECTROMETERS. Final report, 1 November 1967-31 October 1972. Copic, M. (International Atomic Energy Agency, Vienna (Austria)). Nov 1972. vp. INIS.

Threshold foil activation is widely used for measurements of fast neutron spectra, but it usually gives less accurate results than do scintillation or semiconductor spectrometers requiring more sophisticated procedures and modern equipment. A comparison of fast neutron spectra measured by the activation method and one based on a scintillation spectrometer were performed to make a more accurate calibration of the unfolding techniques by which threshold detector measurements are converted to spectra and thus to permit reliable spectra measurements to be made at modestly equipped laboratories by the simple threshold detector method. The research showed that accurate calibration of threshold detectors in a pure fission spectrum can be performed at modestly equipped laboratories attaining relative accuracies from 3 to 10% for fission-spectrum-averaged activation cross section in the millibarn region. The accuracies from 2 to 5% can also most likely be achieved with further improvements of the methods used for measurements and analysis. Such methods as the ITER-2 program developed and analyzed during the research that are based on iterative procedure and use activation cross sections are reliable for unfolding foil activation data and give the fast neutron spectra with good resolution, provided a sufficient number (for example 7) of distinct threshold detectors is used. (INIS)

610 (KHFTI-73-7) SPECTROMETER EXPERIMENT PROGRAMMING. Koltunov, I. A. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1973. 16p. (In Russian). INIS.

One of the problems of the optimum planning of spectrometric experiments lies in the proper counting installation so that in given time of use of the accelerator beam unknown parameters of the angular distribution of particles can be obtained with the optimum precision or unknown parameters can be evaluated with sufficient precision. The recommendations are based on the Fisher information criteria. (tr-auth)

611 (KHFTI-73-13, pp 76-77) X RAY AND SOFT GAMMA RADIATION SPECTROMETER WITH THE Si(Li) DETECTOR. Khomyakov, G. K.; Serykh, N. V.; Strashinskii, A. G.; Skakun, N. A.; Poryatui, V. S. 1973. (In Russian).

The basic characteristics of a spectrometer using a Si(Li) detector with a thickness of the sensitive layer of 1.5 mm and diameter of 5 mm are described. The results of the application of this spectrometer to the analysis of the γ radiation spectra from ^{241}Am sources and the x radiation of Al and W are reported in graphic form. (INIS)

612 OPTIMAL PLACEMENT OF A SPECIMEN IN RELATION TO A DETECTOR. Silant'ev, A. N.; Shkuratova, I. G. Sov. At. Energy (Engl. Transl.); 34: No. 6, 583(Jun 1973).

Translated from At. Energ. (USSR); 34: No. 6, 477(Jun 1973). This is a summary of paper No. 672/6903 with full copy held at TIC.

In the γ-spectrometric analysis of specimens with low specific activity, it is very important to place the specimen in the optimum position with respect to the detector. We calculated the optimal values of specimen radius and of the product of solid angle and self-absorption coefficient for a number of values of the specimen volume. The calculations were carried out for three values of μ, the coefficient of absorption of γ-radiation in the specimen material, and for cases in which the specimen was placed either over the end surface of the detector or around the detector. All values are shown in relative units of detector radius. In the calculations it was assumed that the distance between the end surface of the crystal and the material of the specimen was 0.15; the distance between the lateral surface of the crystal and the material of the specimen was assumed to be 0.25. (WHK)

613 RECONSTRUCTION OF THE SPECTRA OF NEUTRONS HAVING ENERGIES OF 0.4 eV-10 MeV FROM MEASUREMENTS MADE WITH A SET OF SPLITTING-ISOTOPE DETECTORS. Doroshenko, G. G.; Zaitov, A. M.; Koshaeva, K. K.; Kraitor, S. N.; Leonov, E. S.; Tarasko, M. Z. Sov. At. Energy (Engl. Transl.); 35: No. 5, 1025-1026(Nov 1973).

Translated from At. Energ. (USSR); 35: No. 5, 343-348(Nov 1973). This is a summary of paper No. 697/7232 with full copy held at TIC.

For slow and intermediate neutrons, ^{235}U is used with five ^{10}B filters having thicknesses of 0.1, 0.4, 1.0, 4.0, and 10 g/cm^2. For fast neutrons, ^{237}Np, ^{231}Pa, ^{236}U, and ^{238}U foils and ^{32}S and ^{27}Al activation detectors were used. Neutron spectra of some reactors and critical facilities were reconstructed and are presented. (WHK)

614 NEUTRON SPECTROMETER ON THE BASIS OF SPLITTING ISOTOPES. Koroleva, T. V.; Koshaeva, K. K.; Kraitor, S. N. Sov. At. Energy (Engl. Transl.); 35: No. 5, 1026(Nov 1973).

Translated from At. Energ. (USSR); 35: No. 5, 344(Nov 1973). This is a summary of paper No. 698/7233 with full copy held at TIC.

The detectors were composed of ^{235}U, ^{235}U + Cd, ^{235}U + 1 g/cm^2 ^{10}B, ^{237}Np, ^{238}U, and ^{32}S. The design and calibration of the spectrometer are discussed and some results are given. (WHK)

615 ENERGY RESOLUTION OF SEMICONDUCTOR DETECTORS IN COUNTING IONS HAVING KILOVOLT ENERGY. Arkhipovich, V. A.; Kolyada, V. M.; Korobko, G. S. Poluprov. Tekh. Mikroelektron.; No. 15, 13-19(1974). (In Russian).

Measurement of the energy spectrum of protons reflected from a single-crystal surface can be used to solve a broad circle of problems in studies on amorphous layers, structural imperfections, atomic impurity composition and thin films. It is possible to do this only by using counters having an energy resolution ΔE on the order of a few keV. The study investigates the possibility of obtaining this resolution by means of semiconductor surface detectors for counting protons in the energy region down to 200 keV. (14 references, 6 figures) (SJR)

616 LIMITS OF MEASUREMENT IN GAMMA-RAY SPECTROMETRY. Ionescu, C. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 25: No. 5, 583-594(1973). (In Rumanian).

The topics cover statistical procedures, critical and detection limits in spectrometry, experiments, and the ultimate detection sensitivity of Ge(Li) gamma-ray spectrometers. (auth)

High Energy Physics Instrumentation

Refer also to abstracts 2609 and 2610.

617 DEVELOPMENT OF PROPORTIONAL COUNTER FOR HIGH-ENERGY PRIMARY COSMIC RAY MEASUREMENT. Kuge, A. (Rikkyo Univ., Tokyo). Uchusen Kenkyu; 17: No. 4, 530-539(Feb 1973). (In Japanese).

From symposium on charged particles and cosmic radiation; Hamamatsu, Japan (Dec 1971).

The energy of primary cosmic rays, presently observed in the neighborhood of the earth, is less than 10 GeV. However, more precise observation and data accumulation concerning the higher energy region above 10 GeV will clarify the structure of interstellar space. The observation plan is programmed first to carry out the observation at ballon height to grasp the outline of the source of cosmic rays and the structure of interstellar space. A proportional counter has been designed for the ground test with muons. Since the muon is a singly charged particle, it may be considered that the magnitude of its ionizing loss is the same as that of the proton. At first, good results were not obtained because of the unexpectedly small effective volume. Then a chamber was manufactured for trial, which is long and slender to decrease the edge effect, and the distance of electrodes was made short to get multi-stage construction, and a collecting electrode wire of 50 μm was used so as to operate even at low voltages. Preliminary tests will be performed to study problems with this improved proportional counter. (JA)

618 OBSERVATION OF LIGHT SIGNAL AT THE TRANSIT OF CHARGED PARTICLE THROUGH THE MULTIWIRE PROPORTIONAL CHAMBER. Anokhin, M. V.; Bondarenko, E. A.; Kukareb, V. M.; Marikyan, G. G.; Nikitin, N. I.; Kharitonov, V. M. (Erevan Inst. of Physics). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 8: No. 5, 362-366(1973). (In Russian).

The light signal was observed simultaneously with the current pulse at the transit of relativistic electrons. The mixture of CO_2, Ar, Ne and C_2H_5OH was used as the working gas. The significant magnitude of the light signal allows one to consider its practical application in the designing of particle detectors. (auth)

Radiometric Instruments

Refer also to abstract 590.

619 (AED-CONF-73-223-003) AUTOMATIC CONTINUOUS DENSITY DETERMINATION USING GAMMA RAYS. Brown, D. J.; Nolan, P. F.; Rothwell, E. 1973. 1p. (In German). (CONF-730698-2).

From European meeting on chemical engineering and ACHEMA congress; Frankfurt am Main, F. R. Germany (20 Jun 1973).

620 (COO-3487-1) NUCLEAR SEDIMENT GAGE FOR USE ON THE DEEP OCEAN SEDIMENT PROBE. Final Report. Roney, J. R.; Rose, V. C. (Rhode Island Univ., Kingston (USA). Dept. of Ocean Engineering). 1974. Contract AT(11-1)-3487. 90p. Dep. NTIS $7.50.

A research project to design, construct, test and evaluate a device for in-situ measurement of the density of marine sediments included a detailed investigation of close-spaced, collimated backscatter gamma gages. The design requirements for a gage system suitable for use on the Deep Ocean Sediment Probe (DOSP) gave strong preference to a single probe backscatter system. The research investigation included analysis of gamma radiation scattering in the near field between the source and the detector with the inclusion of a Monte Carlo simulation and two and three dimensional laboratory scattering experiments. A prototype system was designed, constructed and field demonstrated. (auth)

621 (PB-231646) SOIL TESTS WITH NUCLEAR DENSITY-MOISTURE EQUIPMENT: LABORATORY AND FIELD TESTS OF PROBE-EQUIPPED SURFACE-TYPE NUCLEAR DENSITY-MOISTURE EQUIPMENT FOR EVALUATION TOWARD FUTURE USE IN EARTHWORK CONTROL. Merriman, J. (Bureau of Reclamation, Denver, Colo. (USA)). Nov 1973. 36p. (REC-ERC-73-21). NTIS $3.25.

Results of tests with late-model nuclear test equipment on soils in the laboratory and at Pueblo Dam near Pueblo, Colo. are presented. The purpose was to determine if this method of measuring soil moisture and density had sufficiently improved so that it could be substituted for present methods or incorporated into present compaction control procedures. (GRA)

622 RADIATION GAGE WITH SAMPLE AND HOLD FEATURE IN DEVIATION MEASURING CIRCUIT. Bartlett, W. G.; Mangan, E. L. (to Bethlehem Steel Corp.). US Patent 3,832,551. 27 Aug 1974. Filed date 22 Jun 1972. 6p.

The utility of a radiation gage having a direct-reading measuring circuit for determining a material property, such as thickness, density, or weight-per-unit area, is extended by use of a thickness deviation measuring circuit arrangement. In a thickness deviation gage, for example, the latter circuit arrangement includes a sample-and-hold circuit for automatically storing an initial thickness signal detected when the material first enters the gage, and a difference amplifier for comparing instantaneous or subsequent thickness signals with the stored thickness signal and producing a thickness deviation signal. The thickness deviation signal plus the stored and instantaneous thickness signals are fed separately to utilization devices such as indicators and recorders as used in the thickness profile analysis of said material from end-to-end, or said thickness deviation signals may provide a control signal in an automatic control system. (Official Gazette)

623 WIDE-RANGE RADIATION GAGE FOR DETERMINING DEVIATION OF A MATERIAL PROPERTY WITH A CONTROLLED-GAIN DETECTOR IN AN INTERRUPTABLE SELF-BALANCING MEASURING LOOP. Bartlett, W. G.; Hoffman, C. D.; Jones, D. T.; Mangan, E. L. (to Bethlehem Steel Corp.). US Patent 3,832,550. 27 Aug 1974. Filed date 22 Jun 1972. 12p.

Deviation of a gaged material property, such as material thickness, density, or weight-per-unit area, from a nominal value in a wide range of values is determined by a single-range, penetrative-beam type of radiation gage having an interruptable self-balancing measuring loop that includes a controlled-gain detector, thereby providing the radiation gage with a continuously variable gain characteristic. Any nominal value of material gaging property may be pre-established in a wide range of values by inserting digital material standards from a built-in magazine into the radiation beam, thereby causing the self-balancing loop to balance at a corresponding point in the variable sensitivity range. The presence of material to be gaged is detected before entering the radiation beam and interrupts and holds the self-balancing loop at the preset nominal value, while also removing the standards from the radiation beam. Subsequent measuring signals, together with a nominal value signal, are processed in a deviation gain adjusting circuit, whereby a linear deviation signal throughout the entire variable gain range is produced and fed to a deviation indicator. (Official Gazette)

624 EXACTNESS IN DETERMINING SOIL MOISTURE BY NEUTRON PROBE. Schefke, R. (Wyzsza Szkola Rolnicza, Poznan, Poland). Pr. Zakresu Les.; 32: 163-178(1971). (In Polish).

The results of a study on the accuracy in measuring moisture in sandy soil, using the NIW-1 neutron moisture gage with a Pu-Be source are presented. The analysis of measurement accuracy was based on moisture measurements carried out in 4 profiles of meadow soils and in 6 profiles of forest soils. The comparative measurements were made by the gravimetric method. The investigations showed the existence of a high correlation between both methods. The correlation coefficients ranged from 0.901 to 0.975, the standard errors of estimate were from ± 0.86 to ± 1.28% of volumetric moisture. The measurements were more exact in meadow soils than in forest soils which was connected with the existence of a layer of roots of trees. Gage NIW-1 demands drawing separate calibration curves for the given kind of soil and knowing its bulk density. In interpretation of results of measurements with the neutron moisture gage, better results were obtained when assuming the radius of the sphere of influence $R = 0.75 \times 15 \sqrt[3]{100/W}$. (auth)

625 A NOTE ON THE EQUATION OF THE GAMMA RAY BACKSCATTER SURFACE DENSITY GAUGE. Preiss, K.; Haccoun, A. (University of the Negev, Beersheba (Israel)). Nucl. Eng. Des.; 30: No. 1, 123-125(Jul 1974).

Several equations proposed for a gamma ray backscatter surface density gage were obtained by fitting functions to experimental curves. Recently, a single general equation has been derived which gives the distribution of back-scattered radiation, with distance from the source, for many source energies and materials. In this paper that equation is used to derive the equation relating count rate and density for a backscatter gage. (auth)

626 WIDE RANGE RADIATION GAGE HAVING A CONTROLLED-GAIN PHOTODETECTOR FOR DETERMINING A

MATERIAL PROPERTY. Bartlett, W. G.; Mangan, E. L. (to Bethlehem Steel Corp.). US Patent 3,832,542. 27 Aug 1974. Filed date 22 Jun 1972. 28p.

A high energy nuclear radiation source and a scintillation detector are combined to gate a material property, such as steel plate thickness, when the material is placed in a beam of radiation. The detector includes a photomultiplier tube which operates in a servo loop with a voltage controlled variable dynode voltage source, the latter controlling tube gain to maintain anode current substantially constant over a wide range of gaging. Gage operation is based on the phenomena of a non-linear photomultiplier tube gain characteristic being inverse and nearly equal to the nonlinear radiation absorption characteristic of the material being gaged. This yields a dynode voltage which varies only slightly nonlinearly as a measure of the material property. The gage includes a linearizer for correcting the nonlinearity of a fraction of the dynode voltage and this signal is ultimately applied to a material property indicator. Also included is an automatic zero adjuster for continuously providing a zero-based gaging signal under variable operating conditions, and a material presence/absence detector for causing the zero adjuster to act only during the absence of material from the gage. In addition, a signal conditioner modifies the linearized signal to compensate for variations in other material properties which affect the gaging property. (Official Gazette)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

627 (AD-775384) RADIATION TOLERANCE OF GaAs BROADBAND AMPLIFIER. Final Report, 1 April–30 September 1973. Zuleeg, R.; Behle, A. F. (McDonnell Douglas Astronautics Co., Huntington Beach, Calif. (USA)). 31 Oct 1973. 42p. (MDC-G-5033; AFCRL-TR-73-0666). NTIS $3.25.

The response and degradation characteristics of microstripline GaAs junction field-effect transistor integrated microwave amplifiers were investigated in radiation environments. Permanent changes in electrical performance due to fluences of 5×10^{14} and 1×10^{15} n/cm^2 (E > 10 keV) are reported and discussed. Experimental results are compared with theoretical predictions of device transconductance changes, which have been established and verified prior to this investigation. (auth)

628 (AD-776913) STUDY OF TRANSIENT RADIATION EFFECTS ON A MONOLITHIC INTEGRATED OPERATIONAL AMPLIFIER CIRCUIT. Schauer, H.; Hudson, P. (Army Electronics Command, Fort Monmouth, N. J. (USA)). Mar 1974. 32p. (ECOM-4206). NTIS $3.25.

The Microamp 776 micropower operational amplifier was irradiated using cobalt-60, linear accelerator, and fast burst reactor environments. The test procedures used, the test results obtained, and an analysis of the radiation induced failures are presented. Offset voltage increased 25% at 5600 rads (Si) ^{60}Co exposure and up to 400% at 1×10^5 power rads (Si) linac exposure. Open loop gain was degraded up to 70% at 6×10^4 power rads (Si). Offset voltage approximately doubled at 4×10^{11} power n/cm (E ≥ 10 keV), which is more significant at lower set currents where offset voltages are initially higher. Open loop gain decreased by up to 80% at 5×10^{11} power n/sq cm, largely due to decreased transistor current gain and partly due to a 30% reduction in quiescent current. (auth)

629 (AD-777088) ADJOINT MONTE CARLO GENERATION OF RADIATION RESPONSE FUNCTIONS FOR COMPLEX MISSILES. Final Report, 1 January 1971–31 August 1972. Scott, W. H. Jr.; Lonergan, J. A.; Woolson, W. A. (Science Applications, Inc., La Jolla, Calif. (USA)). 5 Feb 1974. Contract DASA01-71-C-0044. 72p. NTIS $3.75.

An adjoint Monte Carlo calculation technique for the generation of neutron and gamma-ray radiation response functions in complex, three-dimensional geometries is presented in both general terms to allow an understanding of the method, and with enough calculational detail to apply the technique. The radiation response functions can be folded with any angle-dependent neutron and gamma-ray free field source and any neutron and gamma-ray response. Thus, missile vulnerability can be determined for any damage mechanism which can be expressed as damage per incident neutron or gamma-ray energy for any incident energy-angle dependent source. The MORSE multigroup, coupled neutron-gamma-ray Monte Carlo code was used to perform adjoint transport in current missile systems which were modeled with the combinatorial geometry package. (auth)

630 (AD-777185) STUDY OF ELECTRONICS RADIATION HARDNESS ASSURANCE TECHNIQUES. Volume II, Part 1. Electrical Screening for Neutron Effects. Final Report, 31 July 1970–16 July 1973. Arimura, I.; Johnston, A. H.; Sivo, L. L.; Egelkrout, D. W. (Boeing Co., Seattle, Wash. (USA)). Jan 1974. 173p. (AFWL-TR-73-134-VOL-2-PT-1). NTIS $5.00.

The report describes the results of a comprehensive study which was designed to determine improved techniques for providing radiation hardness assurance on modern electronic systems. The electrical screening approach examined correlations between certain initial electrical parameters and the radiation sensitivities of the devices. The correlation parameters were selected on the basis of physical reasoning and the radiation sensitivities were defined differently for the various radiation environments. Neutron hardness assurance is treated first and the various classes of devices such as low-power transistors, high-power transistors, JFETS and ICS are discussed separately. (GRA)

631 (AD-777186) STUDY OF ELECTRONICS RADIATION HARDNESS ASSURANCE TECHNIQUES. Volume II, Part 2. Electrical Screening for Ionizing Radiation Rate and Total Dose Effects. Final Report, 31 July 1970–16 July 1973. Arimura, I.; Johnston, A. H.; Sivo, L. L.; Egelkrout, D. W. (Boeing Co., Seattle, Wash. (USA)). Jan 1974. 149p. (AFWL-TR-73-134-Vol-2-PT-2). NTIS $4.75.

The electrical screening approach examined correlations between certain initial electrical parameters and the radiation sensitivities of the devices. The correlation parameters were selected on the basis of physical reasoning and the radiation sensitivities were defined differently for the various radiation environments. Ionizing radiation rate hardness assurance is treated with subdivision determined again by the various classes of devices. MTBF results are also discussed for parts subjected to ionizing rate tests. Total dose hardness assurance is discussed for the low-power transistors and for the operational amplifiers separately. Low dose screening is included in this section although it differs slightly from the normal techniques of electrical screening. (GRA)

632 (AD-777187) STUDY OF ELECTRONICS RADIATION HARDNESS ASSURANCE TECHNIQUES. Volume II, Part 3. Electrical Screening for Second Breakdown. Final Report, 31 July 1970–16 July 1973. Arimura, I.; Johnston, A. H.; Sivo, L. L.; Egelkrout, D. M. (Boeing Co., Seattle, Wash. (USA)). Jan 1974. 130p. (AFWL-TR-73-134-Vol-2-PT-3). NTIS $4.75.

The objectives of the second breakdown (SB) program were to determine analytical dependences for IC and power transistor SB susceptibility in neutron and gamma ray environments and to investigate means of prediction of SB in a radiation environment through nondestructive screening methods. (GRA)

633 (AD-777676) FAST NEUTRON IRRADIATION OF PES AND INSE INFRARED DETECTORS. Moore, W. J.; Guenzer, C. S.; Wilsey, N. D.; Molnar, B. (Naval Research Lab., Washington, D. C. (USA)). Mar 1974. 30p. (NRL-MR-2770). NTIS $3.25.

The effects of fast neutron irradiation on lead sulfide and indium antimonide infrared detectors is reported. A threshold for lead sulfide detectors has been established at 2×10^{12} n/cm^2 power n/sq cm with approximately 75% of the degradation attributable to a reduction in majority carrier lifetime. When stored at 300° K, the detectors return to their original condition in tens to hundreds of days. Restoration of signal proceeds logarithmically with time rather than exponentially as is usually observed. For indium antimonide photovoltaic detectors, a threshold of 2×10^{11} power n/sq cm has been observed. Measurements show that neutron irradiation produce both an increase in noise and a decrease in signal. These effects result from a decrease in (1) the leakage resistance, (2) the effective carrier lifetime in the depletion region, and (3) the hole diffusion length in the base region. (auth)

634 DAMAGE EFFECTS OF SILICON SURFACE BARRIER DETECTORS WITH PROTONS, ALPHAS, AND NITROGEN IONS. Nakamoto, S. (Chubu Inst. of Tech.; Kasugai, Japan); Aoki, T.; Kawabata, K. Mem. Chubu Inst. Technol.; 9: 87-98(Dec 1973).

Silicon surface barrier detectors were irradiated with protons (0.5 to 2 MeV), alphas (1 to 6 MeV) and nitrogen ions (1 to 4 MeV). The radiation damage effects in electrical properties of the detectors have a correlation with the defect properties and distribution. A model is proposed by which some of the damage effects are explained consistently and the damage rate is estimated. The irradiated detectors have been annealed up to 400°C and the defect recovery has been investigated. (auth)

635 RADIATION HARDENED FLIP-FLOP. Parks, K. B. (to Secretary of the Army). US Patent 3,833,324. 3 Sep 1974. Filed date 6 Sep 1972. 6p.

Two inductors are inserted in series with the controlling transistors' paths to ground, and diodes shunt the inductors. Further diodes are back connected between the base circuits of the controlling transistors and ground. A third inductor shunted by a diode is connected between the base circuits of the toggle transistors and ground. The time constants of these circuits are selected such that the flip-flop returns to its initial state after a high radiation level has subsided due to the stored energy in one of the inductors. (Official Gazette)

636 POSSIBILITIES OF ELIMINATING COMPOSITION ERRORS IN GAMMA RAY BACKSCATTER DENSITY MEASUREMENT. Votava, P. (Vyzkumny Ustav Stavebnich Hmot, Brno (Czechoslovakia)). Nucl. Eng. Des.; 30: No. 1, 126-133(Jul 1974).

The method of determining soil and building material densities by gamma ray backscatter gages has been developed successfully in recent years. However, with regard to the accuracy of measurement, this method is subject to various sources of interference which are being eliminated more or less successfully in the course of its practical application. One of the major factors affecting accuracy unfavorably is the variation in chemical composition of samples tested. In this paper the possibility of eliminating errors due to variation in chemical composition by using the air-gap technique of the dual-gage principle is discussed. Results of experimental measurements using these two methods are compared with results achieved by the single-gage technique using one detector seated close to the surface of the sample tested. The values obtained are analyzed by a Hewlett-Packard 9820 computer program. The results of various measurements are given and compared. All measurements were accomplished by means of an NaI(Tl) scintillation detector and for ^{137}Cs and ^{60}Co sources. (auth)

637 BARRIER CAPACITANCE OF DIFFUSION, SILICON p–n-TRANSISTORS IRRADIATED WITH FAST NEUTRONS. Emel'yanova, T. S.; Kozhukhova, E. A.; Shakhovtsov, V. I. (Inst. of Physics, Kiev). Poluprov. Tekh. Mikroelektron.; No. 14, 55-64(1974). (In Russian).

A study was made on the behavior of the barrier capacity C_b of diffusion silicon p-n-transistors obtained by thermal diffusion of B and Al into n-Si with $\rho = 2$ to 80 ohm-cm after irradiation with fast neutrons from a reactor. From an analysis of the volt-ampere characteristics of the irradiated p-n-transistors it can be concluded that fast neutron irradiation leads to the occurrence of a compensating layer near the p-n-transition with a conductivity close to the characteristic value. Estimates were made on the dose dependence of the width of this region w_1, and the value of w_1 was calculated with the use of the diffusion parameters of the p-n-transistor and the radiation constants of Si. (SJR)

Miscellaneous Instruments

Refer also to abstracts 420 and 655.

638 (ANL-8096, pp 153-154) CENTRAL REAL-TIME COMPUTER FACILITY. Day, P. P.; Hines, J. J.; Zielen, A. J. Apr 1974.

In Chemistry Division annual report, July 1972–June 1973.

The ANL Chemistry Division's Sigma-5 real-time central computer system is briefly described. The interactive graphics capability is discussed, and new experiments implemented on the system are outlined. (WHK)

639 (EGG-1183-4069) PATTERN DISTORTION STUDIES. Spector, J. (EG and G, Inc., San Ramon, Calif. (USA)). Jul 1973. 29p. Dep. NTIS $4.00.

A study of the causes of pattern distortion on cathode ray tubes used for nuclear test data recording was performed. Specific design and manufacturing defects were found to be responsible for the major types of distortion, and new designs and manufacturing techniques were initiated. Each of 10 cathode-ray tubes that had exhibited distortion was tested before and after its remanufacture using the improved designs and techniques. A comparison of test results indicates that a significant reduction of distortion was accomplished in each case. Keystoning, the type of distortion that had been most severe, was reduced from an average of 5 tracewidths to an average of 1.25 tracewidths. (auth)

640 (IPPJ-T-17) CALIBRATION OF THE ELECTROSTATIC ENERGY ANALYZER FOR QUANTITATIVE UTILIZATION. Saad, H. M. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Nov 1973. 12p. NTIS (US Sales Only).

The problems associated with the calibration process of electrostatic analyzers for quantitative utilization are the ion source, the detector, and the measuring system. A simple ion source to fit such process was selected and calibrated. It gave a linear relation between the electron emission current and the output ion current. The Daly-type detector was used and its characteristic curves are plotted. The absolute amplification factors for both the target and the scintillator are deduced at different target potentials. Finally, the counting method was applied. It showed linearity for comparatively small currents after which it was saturated due to the pile up problem. (auth)

641 (MLM-2173(OP)) AUTOMATED THETA–THETA DIFFRACTOMETER AND SAMPLE CONTAINMENT SYSTEM FOR THE INVESTIGATION OF LIQUIDS AND SOLIDS AT HIGH TEMPERATURES. Hudgens, C. R. (Mound Lab., Miamisburg, Ohio (USA)). 1974. Contract AT-33-1-GEN-53. 14p. (CONF-740838-1). Dep. NTIS $4.00.

From meeting of the American Crystallographic Association; University Park, Pennsylvania, USA (19 Aug 1974).

A theta-theta diffractometer (Picker) was modified for computer control by the installation of a stepping motor and an absolute encoder on the two-theta drive shaft. The detection system consists of a balanced filter, scintillation counter, and conventional PHA electronics inputting into computer-compatible high-speed scalers. The sample support is a hollow, refractory metal post, heated from within by an electron beam concentrated under the sample. This arrangement eliminates all heavily outgassing materials in the sample chamber and facilitates the construction of a mechanically robust system. The sample is protected by a controllable-composition, low-pressure atmosphere in a chamber which is completely isolated from that of the electron beam heater. Since the system is presently used for studies on highly active metals, atmospheres of helium or argon are used. The chemically reactive gas concentration is kept below 10^{-14} mm by recirculating the gas at high speed over evaporating barium. A specially designed mercury vapor pump, conventionally trapped, is used as a positive pressure pump for recirculation of the gas. Reducing conditions may be provided by controlled addition of hydrogen to the atmosphere through a palladium diffuser. The system was designed for the determination of the liquid structures of the transuranium elements. Liquid cerium has been successfully handled in the system. (auth)

642 DIGITAL RECORDING METHOD FOR THE RESULTS OF RADIOMETRIC MEASUREMENTS. Bovin, V. P.; Volodin, K. M.; Eremin, A. A.; Lintser, A. A. Sov. At. Energy (Engl. Transl.); 34: No. 2, 165-166(Feb 1973).

Translated from At. Energ. (USSR); 34: No. 2, 127-128(Feb 1973).

In connection with the preparation of designs for automatic control systems (ACS) by geological prospecting and mining enterprises (particularly at uranium mines), a problem of special importance is that of automatically recording and coding geophysical information (data from gamma logging or the testing of ore in a pillar, or results of rapid gamma analysis of excavated ore). The main requirements for instruments used for geological prospecting work in quarries and pit mines are that the instruments must be portable and must have self-contained power supplies. With these requirements in mind, a system has been worked out for the automatic recording and coding of data from radiometric measurements in such a way that the data can be fed directly into electronic digital computers of the Minsk 22, Minsk 32, and Mir types. The system is designed to present in digital form either continuous measurements (gamma logging of vertical and inclined boreholes) or discrete measurements (gamma logging of horizontal and ascending underground boreholes, gamma sampling of mine output, and rapid gamma analysis of excavated ore directly in mine cars or other transport containers). (WHK)

643 AUTOMATIC SPLITTER FOR WET TABLING OF RADIOACTIVE ORES. Nair, J. S.; Degaleesan, S. N.; Majumdar, K. K. (Bhabha Atomic Research Centre, Bombay). Inst. Mining Met., Trans., Sect. C; 83: C121-C123(1974).

An automatic band splitter is described, which consists of a scanning unit to which the splitter is attached, a count rate electronic circuit with an optical meter relay and a driving mechanism actuated to move the splitter and the detector assembly automatically. Results of tests with low-grade uranium ores are presented. It is stated that use of the automatic splitter shows that the recovery of uranium ores in the concentrate could be improved considerably, and further work in progress is mentioned. (UK)

644 GAS VOID DETECTOR FOR LIQUID METAL. Jaross, R. A. (to United States Atomic Energy Commission). US Patent 3,830,095. 20 Aug 1974. Filed date 26 Jun 1973. 4p.

Detection of gas voids in a liquid metal is accomplished by pumping the liquid metal through a flowmeter with an electromagnetic pump. The flowmeter measures the rate of flow of the liquid metal which decreases with the presence of gas voids in the liquid metal. When the flow rate is reduced because of the presence of such gas voids an alarm signal is generated. (Official Gazette)

645 LIQUID CRYSTAL IMAGE CONVERTER SYSTEM RESPONSIVE TO IONIZING RADIATION. Assouline, G.; Hareng, M.; Leiba, E. (to Thomson-CSF). US Patent 3,829,684. 13 Aug 1974. Priority date 25 Apr 1972, France. 6p.

The invention relates to the display of visible images corresponding to patterns projected by means of ionizing agents such as x-rays, γ-rays or particle beams. The image converter in accordance with the invention comprises a fluorescent screen optically coupled to a photoconductive film, the latter being electrically coupled to a liquid crystal film whose dynamic scattering properties are utilized to render visible the patterns projected onto the fluorescent screen by means of the ionizing radiation. (Official Gazette)

646 PROCEEDINGS OF THE NINETEENTH INTERNATIONAL ISA AEROSPACE INSTRUMENTATION SYMPOSIUM, LAS VEGAS, NEVADA, MAY 21–23, 1973. Washburn, B. (Ed.). Instrumentation in the Aerospace Industry, Volume 19. Pittsburgh; Instrument Society of America (1973). 318p. (CONF-730510-).

Thirty-six papers were presented at the symposium. A separate abstract was prepared for each of 2 papers. The remaining 34 papers were not within the scope of NSA. (LCL)

For abstracts of individual papers see: 479 and 514.

647 RADIOACTIVE WELL LOGGING TO DISTINGUISH WATER AND HYDROCARBON SATURATION BY DELAYED NEUTRONS FROM OXYGEN. Caldwell, R. L. (to Mobil Oil Corp.). US Patent 3,829,687. 13 Aug 1974. Filed date 25 Apr 1973. 10p.

A well logging process for exploring for petroleum hydrocarbons in which subterranean formations are characterized with regard to their hydrocarbon or water saturation on the basis of their oxygen content is described. The well under investigation is subjected to a porosity logging procedure such as neutron logging, self potential logging, gamma ray scattering density logging, or acoustic velocity logging in order that one or more formations of relatively high porosity may be identified. Such formations are subjected to a delayed neutron logging procedure in which a formation is irradiated with repetitive bursts of fast neutrons spaced by time intervals greater than the time required for dissipation of neutrons originating in the bursts. Between the bursts and after dissipation of the original source neutrons, a detector is operated in order to detect delayed neutrons resulting from the neutron irradiation of oxygen-17. The radiation count thus obtained provides an indication of the oxygen content of the formation. (Official Gazette)

648 MAIN FEATURES OF A NONLINEAR OPERATING MODE OF A BENNETT MASS-SPECTROMETER. Kaplin, V. A.; Fadeev, S. I.; Shvedova, K. V. Vychisl. Sist.; No. 56, 102-129 (1973). (In Russian).

A study of a mathematical model of a radiofrequency Bennett mass-spectrometer shows that with transition and a nonlinear mode of operation there is a substantial decrease in the level of secondary harmonics, and there is an increase in the resolution. The study presents formulas for aligning the equipment, and also the results of calculating a number of variants illustrating features of the nonlinear operational mode. An experiment that is described agrees well with the theory. In view of the rather small flight path the probable field of use of nonlinear operating modes of the mass-spectrometer would be in the mass analysis of charged particles at pressures of 10^{-2} torr and in the separation of intense ion fluxes of large cross-section. (SJR)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstracts 95–99 and 1346.

649 CENTRIFUGE FOR SEPARATION OF ENRICHED ^{235}U. Oyama, Y.; Takashima, Y.; Aoki, N. (to Power Reactor and Nuclear Fuel Development Corp.). Japanese Patent 1973, 11278. 26 Oct 1967. 4p. (In Japanese).

A centrifuge for separation of enriched ^{235}U is described using a gas mixture as a starting material, which is composed of a light inert gas and a UF_6 gas, without resorting to the cold trap method. The centrifuge includes a stationary outer cylinder, a cylindrical rotor rotatably accommodated within the outer cylinder for forming between an annular clearance, and a heating device and a cooling device interposed in the clearance, respectively, at the upper and lower ends of the same. The rotor has its upper and lower shafts of rotation formed with a gas inlet hole for introduction of the gas mixture, which contains the light inert gas and the UF_6 gas in the same amount, and with a gas outlet hole for extraction of the light inert gas content. The upper and lower end plates of the rotor are formed with gas outlet holes for discharge, respectively, of an enriched gas of ^{235}U and of the depleted gas in the same amount. The outer cylinder has, on the other hand, its drum portion formed with a gas outlet pipe, which in turn is formed with a gas outlet hole for injecting the light inert gas from the lower shaft of rotation into the clearance in the tangential direction of the cylindrical rotor. The upper and lower ends of the outer cylinder are formed with gas outlet pipes which accommodate control valves. (JA)

650 CALCULATION OF THE THERMAL DIFFUSION COLUMN PERFORMANCES FOR NEON ISOTOPE SEPARATION. Toderean, A. (Univ. Babes-Bolyai, Cluj); Vasaru, G. Stud. Cercet. Fiz.; 26: No. 2, 135-142(1974). (In Rumanian).

The results of the calculation of the transport coefficients, the maximum value of the total separation factor at equilibrium, the optimum pressure operation, the equilibrium time and the equilibrium concentration of ^{22}Ne isotopes at both ends of a thermal diffusion column are presented. These calculations are performed for two molecular models; i.e., the inverse power repulsion model and Lennard-Jones model. (auth)

651 DETERMINATION OF THE OPERATION PARAMETERS OF A THERMAL DIFFUSION CASCADE. Covaci, I.; Vasaru, G.; Toderean, G. (Inst. of Stable Isotopes, Cluj). Stud. Cercet. Fiz.; 26: No. 2, 143-163(1974). (In Rumanian).

The algorithm proposed by Rutherford and Keller has been developed for the determination of the optimal operation parameters of a thermal diffusion cascade. Further, a new numerical algorithm for the calculation of these parameters has been elaborated, which then has been compared, in a favorable manner, with the previous one. A logical scheme for the preparation of a computer program is also presented. (auth)

652 HIGHLY SELECTIVE EXCITATION OF ATOMS AND MOLECULES USING TWO-PHOTON PROCESSES. Kelley, P. L.; Kildal, H. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.); Schlossberg, H. R. (Air Force Cambridge Research Labs., Bedford, Mass. (USA)). Chem. Phys. Lett.; 27: No. 1, 62-66(1 Jul 1974).

Two-photon processes in gases can be enhanced and selectivity, increased by choosing the relative direction between the photons so as to minimize the effect of the Doppler shift. The techniques considered can be important in the employment of lasers for isotope separation. Estimates are made of the degree of narrowing and enhancement obtainable as well as of the power levels required. (auth)

653 THE SEPARATION NOZZLE METHOD FOR THE ENRICHMENT OF THE LIGHT URANIUM ISOTOPE U-235. Schuette, R. (Karlsruhe Univ. (TH) (F. R. Germany). Inst. fuer Kernverfahrenstechnik). Fridericiana; No. 13, 32-40(Nov 1973). (In German).

9 figs.; 12 refs.

The basic principles of the procedure, the technical state of development, the economic aspects of the separation nozzle method and further physical development were studied. (GE)

654 INCREASING THE EFFICIENCY OF ISOTOPE SEPARATION CASCADES BY USING STAGES WITH A NUMBER OF OUTPUT FLUXES. Kolokol'tsov, N. A. At. Energ. (USSR); 37: No. 1, 32-34(Jul 1974). (In Russian).

Various schemes of cascades consisting of stages with three outputs have been considered. Equations describing the separation process in such cascades have been obtained. It is shown that the use of nonsymmetrical cascades consisting of stages with three outputs makes it possible to increase cascade efficiency by 57%. (auth)

655 INHOMOGENEOUS MAGNETIC FIELD $N \leq 1$ PRISM IMAGE SHIFT DUE TO THE SPATIAL CHARGE. Ioanoviciu, D.; Ardelean, P. (Inst. of Isotope Stability, Cluj). Stud. Cercet. Fiz.; 25: No. 5, 623-628(1973). (In Rumanian).

The space charge effect in mass spectrometers and electromagnetic separators using magnetic prisms with $n \leq 1$ was analyzed. The calculations refer to the space charge effects on the following beam path ranges, i.e., from the ion source to the magnetic field entry boundary, between the magnetic field boundaries, and from the magnetic field exit boundary to the collector. The space and charge features of different prisms are compared. (auth)

656 SEPARATION OF ISOTOPES BY LASER DEFLECTION OF ATOMIC BEAM. I. BARIUM. Bernhardt, A.F.; Duerre, D.E.; Simpson, J.R.; Wood, L.L. (Physics Department, University of California, Lawrence Livermore Laboratory, Livermore, California 94550). Appl. Phys. Lett. 25: No. 10, 617-620 (15 Nov 1974).

Spatial separation of isotopes of barium in an atomic beam has been demonstrated, using radiation pressure of light from a tunable dye laser which resolved the unusually narrow isotopic hyperfine structure of the Ba (I) 5535.7–Å resonance line. Observations of the deflected monoisotopic beam indicate an average of 25 photons scattered per atom in the deflected beam. (auth)

657 THERMAL DIFFUSION COLUMN FOR THE SEPARATION OF ^{13}C. Vasaru, G.; Ghete, P.; Covaci, I.; Pamula, A. (Inst. of Stable Isotopes, Cluj). Stud. Cercet. Fiz.; 26: No. 3, 249-265 (1974). (In Rumanian).

A concentric tube-type thermal diffusion column was constructed and the separation factor of the column was measured as a function of the methane gas pressure. A graphic comparison of the theoretical results for various molecular models with the experimental data shows that the inverse power repulsion model and the Lennard-Jones model gave separation factor values which agreed fairly well with the experiment. A thermal and hydrodynamic study of the column is also presented. (auth)

Isotopic Power Sources

Refer also to abstracts 395 and 1308.

658 (BNWL-1856) SNS SOURCE TERM EVALUATION PROGRAM. Annual Report. Craig, D. K.; Cannon, W. C.; Filipy, R. E.; Mahlum, D. D.; Smith, V. H. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Aug 1974. Contract AT(45-1)-1830. 28p. Dep. NTIS $4.00.

Plutonium-238 is currently being used in the form of a pure refractory oxide as a power source on a number of space vehicles that have already been or will be launched during the next few years. Although the sources are designed and built to withstand re-entry into the earth's atmosphere and impact with the earth's surface without releasing any Pu the possibility of such an event can never be absolutely excluded. Should the capsule fall into the ocean, the corrosive effect of salt waters must be considered. On land, in addition to the possibility of an immediate release from a fractured capsule, the long-term effects of thermal and humidity cycling must be considered. Should $^{238}PuO_2$ become mixed in a finely divided form with soil, the resuspension characteristics of the Pu in conjunction with the soil and the subsequent aerodynamic behavior of the aerosols will be major factors in determination of the fate of the Pu in the environment. Research studies to evaluate the hazards of ^{238}Pu released from space nuclear system (SNS) power sources are outlined. Methods used for the co-generation of aerosols of ^{238}Pu and soils and sampling methods used to determine their transport at various wind speeds are described. (CH)

659 (PB-231999) DEVELOPMENT OF A THERMAL RANKINE-CYCLE ENERGY SYSTEM. Annual Report, June 1968–December 1969. Huffman, F. N. (Thermo Electron Corp., Waltham, Mass. (USA)). 9 Mar 1970. Contract PH-43-68-1455. 260p. (TE-4100-117-70). NTIS $6.50.

The development of an implantable Rankine-cycle power system which actuates a left ventricular assist pump is summarized. Although the prototype employs electrical power transmission, the system has been designed within the constraints of utilizing a radioisotope heat source. A LiF/LiCl eutectic mixture is used for thermal energy storage. A non-expanding Rankine engine is coupled to the assist pump via a hydraulic control system. Electromagnetic power transfer utilizing a tuned ferrite core primary and an implanted secondary was accomplished across intact skin at 70 to 80% efficiency at power levels up to 150 watts. Linear ram and rotary Rankine engines have been designed and tested. Performance has been evaluated in over 1500 hours of bench testing at power outputs up to 20 watts. All subsystems have been integrated into a complete circulatory assist system and subjected to both in vitro and in vivo testing. (GRA)

660 NUCLEAR-FUELED CARDIAC PACEMAKERS. Huffman, F. N. (Harvard Medical School, Boston); Norman, J. C. Chest (Chicago); 65: No. 6, 667-672(Jun 1974).

Nuclear-fueled cardiac pacemakers have reached the stage of clinical evaluation. Approximately 600 units have been implanted in patients. Such pacemakers have the potential of long life. Studies on animals indicate that the somatic and genetic effects from such sealed sources do not preclude clinical use. In our institutions, third-party insurance carriers have assumed their cost. The primary problem is the maintenance of fuel capsule integrity under all creditable conditions. (auth)

Radiation Sources

Refer also to abstracts 399 and 2114.

Design and Fabrication

Refer also to abstract 188.

661 GAMMA-UNIT DEVELOPMENT FOR AGRICULTURAL RADIOBIOLOGY. Bibergal, A. V.; Kaushanskii, D. A.; Lur'e, L. S.; Zhukov, B. G.; Sinitsyn, V. I. pp 96-102 of Primenenie Izotopov i Yadernykh Izluchenii v Sel'skom Kozyaistve. I. Moscow; Atomizdat (1971). (In Russian)

The development of gamma-irradiation units for agricultural biology use is described. The chief studies made were on convenience in carrying out experiments, reproducibility of results, creation of a uniform dose field, possibility of precise dosimetry in the working space, special need for safety techniques in ordinary laboratory arrangements, and minimum need for capital expenditures. In development of industrial equipment, maximum production was obtained with minimum capital investment and with guarantee of a favorable effect of radiation processing. Calculations were made for USSR-produced gamma equipment of various types. Engineering characteristics of the equipment are given. (INIS)

662 METHODS FOR THE PREPARATION OF THIN FILMS AND THIN RADIOACTIVE SOURCES. Constaninescu, F. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 26: No. 3, 307-316 (1974). (In Rumanian).

Methods and experimental techniques for thin film and thin radioactive source preparation are discussed. The advantages of those methods and the precautions in thin film depositions are outlined. (auth)

Industrial Uses

Refer also to abstract 691.

663 (EURISOTOP-89) RADIOACTIVE LABELLING IN THE DEOXIDATION OF STEEL. Litterscheidt, H.; Lohr, D. (Commission of the European Communities, Brussels (Belgium). Bureau Eurisotop). Jun 1974. 174p. (In German). Dep. NTIS (US Sales Only) $6.75.

De-oxidation of often the last metallurgical process before the casting or setting of steel is discussed. The methods used for the de-oxidation and the special problems requiring control during the process are outlined. The use of radioisotopes for labeling the de-oxidation products is discussed in detail with a consideration of its principles, range of applicability, and detection of the radioactive de-oxidation products. Experimental studies made with specific radioisotopes and on 50-kg melts during de-oxidation are reported. The improvements and modifications necessary to make the method of industrial practicality are discussed. (JSR)

664 (IEA-319) OCEAN DISPOSAL SYSTEMS OF THE SEWERS OF SANTOS AND SAO VICENTE. Part No. 3. Measurement of the Sewer Drainage. Garcia Agudo, E.; Duarte, U.; Ohara, T.; Sanchez, W. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Dec 1973. 19p. (In Portuguese). Dep. NTIS (US Sales Only) $4.00.

Measurement of the sewage flow rate is a difficult problem in the field of sanitary engineering. A channel cross section calibration at the CETESB chlorine treatment station, in order to simplify the subsequent measurement of sewage flow, at a permanent stream-gauging station was performed. The total count method was chosen because its advantages over both the current instrument meter and the dilution technique of a radioactive or nonradioactive tracer (rodamine and fluorescein) since the sewage transports materials that might damage the current meter instruments and could also degrade chemical dyes because of the reduction properties of sewage, NH_4Br labeled with ^{82}Br was used as radioactive tracer. The irradiated NH_4Br was dissolved in a sodium thiosulphate solution. In spite of the presence of suspended materials in the sewage and the subsequent delicate operation of pumping out the flowing sewage through a bypass where the measuring system was installed, accurate and reproducible field measurements were obtained. (auth)

665 MEASURING CAR FOR RADIONUCLIDE TESTS AT THE USER'S SITE. Katzenmeier, G. (Kernforschungszentrum Karslruhe (F. R. Germany). Lab. fuer Isotopentechnik). KFK Nachr.; 5: No. 4, 15-20(1973). (In German).

9 figs.; 2 refs.

A brief description is given of the setup and the applicabilities of the measuring car (wear, motion measurement, materials transport processes, thickness, densjty, weight per unit area measurements). (GE)

666 GENERAL CRITERIA FOR THE APPLICATION OF THE NATIONAL LEGISLATION IN THE MANAGEMENT AND CONTROL OF THE RADIOISOTOPES USED IN MEDICAL AND BIOLOGICAL ACTIVITIES. Caldirola, P.; Montesanti, M. I. (Univ., Milan). Energ. Nucl. (Milan); 21: No. 10, 559-570(Oct 1974). (In Italian).

A general technical normative system is suggested, allowing the rules arising from the present national legislation which regulates the management and control of radioisotopes used in medical and biological activities to be put into practice. This system has been applied by the Health Physics Service of the Medicine and Surgery Faculty of the Sacro Cuore Catholic University of Rome, to regulate the movement of the radioisotopes employed in the various hospital sections and scientific institutes. (auth)

667 LES RADIOELEMENTS. Production, Conditionnement, Applications Importantes Au Laboratoire et dan L'industrie. (Radioelements. Production, Conditioning, Important Laboratory and Industrial Applications). Constant, R. J. P. Brussels; Presses Academiques Europeennes (1974). 491p. 1.450 BF.

A book written to provide practical information for the stude. and technician wishing to apply radioelements in the laboratory and industry is presented. Its purpose is not to discuss the theoretical and scientific aspects of radioisotopes, but to provide in an easily accessible form the knowledge necessary for the technician wishing to exploit the possibilities offered by radioisotopes. The elementary concepts of nuclear physics are briefly reviewed. The most common techniques for the use of radioisotopes are described in detail. Methods for the production of artificial radioisotopes are discussed. Détailed practical examples of the use of radioisotopes in the study of mixers, measurement of outputs and leaks, radioactive gages for the measurement of surfaces, densities, levels, pressures, and distances, gammagraphy and neutrography, and radioisotopic batteries are presented. The applications and uses of the effect of radiation on matter are considered from the viewpoint of the technician. (JSR)

LIFE SCIENCES

Radiation Effects on Biochemicals

Refer also to abstracts 111, 142, and 677.

668 (BNWL-1850(PT1), pp 141-144) EFFECTS OF RADIATION-INDUCED RADICALS ON ENZYME ACTIVITY. Felix, W. D.; Kalkwarf, D. R. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Enzymes play a crucial role in the control of cellular functions, therefore, it is important to understand the mechanisms of enzyme reactions following radiation insult. From reported studies on enzymes in aqueous solution, it is apparent that radiation-induced radicals are highly selective in reacting with amino acids present in the protein chain. Generally, the sulfur-containing and ring-structured amino acids are the most radio-labile. The reactions between the enzyme aldolase and various radiation-generated free radicals were investigated. By using γ irradiated crystals of selected compounds, it was possible to examine the inactivation efficiency of specific free radicals without interference from competing radicals. (CH)

669 INFLUENCE OF 5-BROMODEOXYURIDINE ON DNA REPAIR IN CHINESE HAMSTER CELLS EXPOSED TO ULTRAVIOLET RADIATION. Rommelaere, J.; Cornelis, J. J.; Miller-Faures, A.; Errera, M. (Univ., Brussels). Biochim. Biophys. Acta; 340: No. 4, 388-399(Apr 1974).

The kinetics and dose dependence were determined both for the repair synthesis and for the induction and repair of single-strand breaks in the 5-bromodeoxyuridine-substituted DNA of ultraviolet-irradiated Chinese hamster cells. A close temporal relationship was observed between repair synthesis and break sealing. The induction of single-strand breaks was linear with dose, whereas a non-linear response was found for repair synthesis. Since almost all breaks were repaired, the calculated number of bases which could be inserted per repaired single-strand break depended on the dose and was close or inferior to a hundred. (NL)

670 EFFECTS OF X IRRADIATION ON DNA PRECURSOR METABOLISM AND DEOXYRIBONUCLEOSIDE TRIPHOSPHATE POOLS IN CHINESE HAMSTER CELLS. Walters, R. A.; Gurley, L. R.; Tobey, R. A.; Enger, M. D.; Ratliff, R. L. (Los Alamos Scientific Lab., NM). Radiat. Res.; 60: No. 1, 173-201(Oct 1974).

The effect of x-irradiation on DNA precursor metabolism and deoxyribonucleoside triphosphate acid-soluble pools was examined. Pulse-labeling experiments indicated that the rates of incorporation into DNA of thymidine and the ribonucleosides and deoxyribonucleosides of adenine and guanine were similarly reduced in a biphasic manner with increasing doses of x-irradiation. The incorporation rate of cytidine into DNA was reduced after irradiation, while the concurrent incorporation rate of deoxycytidine was greatly stimulated. Incorporation of ^{32}P-phosphate pulse label into nondialyzable DNA after irradiation mimicked that of thymidine; nucleotide analysis of enzymatically degraded DNA pulse-labeled with ^{32}P-phosphate confirmed the results obtained with individual ribonucleosides and deoxyribonucleosides. The purine moieties from deoxyadenosine and deoxyguanosine were efficiently incorporated into RNA. Radiation had no detectable effect on either incorporation into RNA or on the relative distribution of radioactive label from adenosine or deoxyadenosine found as dGMP and dAMP of enzymatically degraded DNA. The dTTP, dATP, and dGTP pools were not expanded after irradiation, nor were the respective pool specific activities significantly altered. The dCTP pool alone was expanded after irradiation. The specific activity of the dCTP pool labeled with deoxycytidine was also increased and accounted for the anomalous radiation-induced stimulation of deoxycytidine incorporation into DNA. Exogenous thymidine abolished both the increased dCTP specific activity and the stimulation of deoxycytidine incorporation into DNA after irradiation but did so not by eliminating either the radiation-induced expansion of the dCTP pool size or the increased intracellular level of [^{3}H]-dCTP derived from [^{3}H]-deoxycytidine but by equalizing the change in magnitude of the two parameters. A radiation effect on deoxycytidylate aminohydrolase is suggested. No radiation effect on the synthesis of dCTP from cytidine was detected. (auth)

671 EFFECTS OF X-IRRADIATION ON COLLAGEN–PLATELET INTERACTION. Kopec, M.; Jelenska, M.; Wegrzynowicz, Z.; Dancewicz, A. M. (Inst. of Nuclear Research, Warsaw). Acta Univ. Carolinae, Med., Monogr.; 53: 41-44(1972).

The influence of x-ray irradiation and of digestion by proteolytic enzymes on collagen was examined in respect to its interaction with platelet. It was found that rather low doses of x rays (1 to 5 kilorads) and digestion by trypsin induce parallel impairment of the ability of salt soluble collagen to polymerize, to aggregate platelets in PRP, and to induce the release reaction. Irradiation of already polymerized collagen remained without influence on its interaction with platelet. (auth)

672 LINEAR AND SIGMOID DOSE-EFFECT RELATIONS: INVESTIGATIONS WITH GAMMA-IRRADIATED THYMINE-(METHYL-T) IN AQUEOUS SOLUTION AND IN THE SOLID STATE. Merwitz, O.; Otto, R. (Nuclear Research Center, Juelich, Ger.). Radiat. Environ. Biophys.; 11: 69-77(29 Mar 1974).

The example of thymine-(methyl-T) demonstrates that in the case of radiation damage to one type of molecule different dose-effect curves will occur depending on the state of the molecule. Radiation-induced tritium cleavage from an aerated aqueous solution of thymine-(methyl-T) shows a linear dose dependence without threshold, tritium cleavage from solid thymine-(methyl-T) follows a sigmoid dose-effect curve with threshold. The G-values for the tritium cleavage from dissolved thymine-(methyl-T) depend on the concentration of the solution, while the G-values for the tritium cleavage from solid thymine-(methyl-T) depend on the dose. The extent of radiation damage in the solid state and in solution is subject to comparative analysis, and the difference in dose-effect relations is discussed. (auth)

673 DNA PHOTOREACTIVATING ENZYME FROM PLACENTAL MAMMALS. Origin and Characteristics. Sutherland, B. M.; Runge, P.; Sutherland, J. C. (Univ. of California, Irvine). Biochemistry; 12: No. 23, 4710-4715(5 Nov 1974).

DNA photoreactivating enzyme in human leukocytes is concentrated in the phagocytotic monocytes and polymorphonuclear cells. Lymphocytes, erythrocytes, spleen, and serum contain little if any enzyme activity. Since bone marrow, which contains immature, nonphagocytotic monocytes and polymorphonuclear cells, also contains high levels of enzyme, it is unlikely that the enzyme in the mature cells resulted from bacteria engulfed by these cells. Photoreactivating enzyme is also found in murine, and in human cells in culture; confluent murine cells have higher specific activity than do rapidly growing cells. The leukocyte enzyme, which requires ultraviolet-irradiated DNA as substrate and visible light for catalysis, converts pyrimidine dimers in DNA to the corresponding monomers in the light-dependent reaction. The action spectrum for photoreactivation extends from 300 to 600 nm, with a peak at about 400 nm. (auth)

Radiation Effects on Cells

Refer also to abstracts 669, 670, 685, 731, 770, and 2688.

674 (AED-CONF-73-430-008) EXPERIMENTS WITH ULTRAVIOLET MICRORADIATION TO DETERMINE THE MOTION MECHANISM OF THE ACHROMATIC SPINDLE. Ernst, D. W. E. (Technische Univ. Hannover (F. R. Germany). Inst. fuer Biophysik; Gesellschaft fuer Strahlen- und Umweltforschung m. b. H., Hannover (F. R. Germany). Inst. fuer Strahlenbotanik). 1973. 5p. (In German). (CONF-7309120-3).

From annual meeting of the Deutsche Gesellschaft fuer Biophysik; Juelich, F. R. Germany (27 Sep 1973).

Two theories regarding the motion mechanism of the achromatic spindle exist at present, namely the theory of gliding microtubuli and the depolymerization theory. Newly fertilized eggs of Lytechinus pictus (sea-urchin) were irradiated with uv microradiation (280 nm) in different regions of the cells during cell division. The irradiation shortened the spindle for a certain period of time, reduced its double refraction and delayed the division. This effect appeared also when the spindle was not directly affected. An interpretation of this effect on the basis of the depolymerization theory is proposed. (GE)

675 (CONF-741018-, pp 151-160) IMPLICATIONS OF DOSE-RATE DEPENDENT CELL-MEMBRANE DAMAGE FOR THE BIOLOGICAL EFFECT OF MEDICAL AND ENVIRONMENTAL RADIATION. Sternglass, E. J. (Univ. of Pittsburgh). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population Exposures.

The recent discovery that cell-membrane damage due to O_2^- free-radical shows an increased biological effectiveness as the dose-rate declines has very significant implications for the basis of the assumptions underlying present radiation protection guides. The assumption of linearity holds only when doses at a given instantaneous dose-rate are compared, as for instance in the case of diagnostic x-ray examinations consisting of different numbers of films. When different doses are administered over a given period of time, as in nuclear medicine or population exposure from environmental sources at various distances, one obtains instead a fractional power-law of the form $y = ax^n$ for the free-radical type of damage, with $n = 0.36$, where y is the effect and x is the total dose. It will be shown that the existing evidence on erythrocyte leakage-rates, bone-marrow cell numbers and viability of cell cultures indicates that cell-membrane damage is the dominant factor in somatic effects of environmental and occupational exposures below 10^{-4} rad/min. By contrast, in the case of the higher dose rates employed in most medical uses and animal studies the direct, mutational type of damage to the genes dominates where DNA repairs leads to the opposite dose-rate dependence. A linear extrapolation from high dose data obtained at high dose-rates may underestimate the low dose, low dose-rate doubling dose for somatic effects by 100 to 1000 times, and overestimate genetic effects by a factor of 10. (auth)

676 DNA SCISSION IN HAMSTER CELLS AND ISOLATED NUCLEI STUDIED BY LOW-VOLTAGE ELECTRON BEAM IRRADIATION. Cole, A.; Cooper, W. G.; Shonka, F.; Corry, P. M.; Humphrey, R. M.; Ansevin, A. T. (Univ. of Texas, Houston). Radiat. Res.; 60: No. 1, 1-33(Oct 1974).

Low-voltage (0.5 to 50 keV) electron beam irradiation of hydrated monolayers of Chinese hamster ovary (CHO) cells and isolated CHO nuclei induced single and double strand DNA scission. Gradient sedimentation techniques were used to assay DNA breakage in control populations having a $2 \cdot 10^8$ number average molecular weight for native DNA and a $2 \cdot 10^7$ number average for denatured DNA. Beam sensitivity responses, expressed as average cell rads/break, exhibited pronounced minima for beams that penetrated less than one third of the cell thickness and less than 1/20 of the nuclear thickness (i.e., top layer irradiation only). Almost half the total DNA population was degraded by these energy beams. A comparison of the breakage efficiency with that for ^{137}Cs γ rays yielded estimates of the relative biological effectiveness (RBE) for low energy electrons (<2 keV) of between 1 and 3. The various results suggest that DNA molecules have multiple attachments at the nuclear membrane and that the radiosensitive sites for cell killing and DNA breakage either are located very close to the nuclear membrane or are more diffuse if high RBE ($\gtrsim 3$) values occur at electron trackends. (auth)

677 EFFECTS OF IONIZING RADIATION ON THE KINETICS OF DNA REPLICATION IN SYNCHRONIZED CHINESE HAMSTER OVARY CELLS. Gerner, E. W.; Meyn, R. E.; Humphrey, R. M. (Univ. of Texas, Houston). Radiat. Res.; 60: No. 1, 62-74(Oct 1974).

The effects of ionizing radiation on the kinetics of semiconservative DNA replication were studied in synchronous populations of Chinese hamster ovary cells by isopycnic centrifugation of DNA, which was density labeled after radiation insult. The proportion of DNA replicated was determined by measuring the amount of DNA that acquired hybrid buoyant density in CsCl gradients. Cells irradiated during mitosis or early G_1 with either 150, 300, or 700 rads exhibited a 0.5-hr, dose-independent delay in the initiation of semiconservative DNA replication. Once initiated, however, the kinetics of DNA replication were unaffected in these populations. As cells moved from early G_1 to late G_1 ionizing radiation effects on the initiation of DNA replication disappeared. Cells, irradiated in late G_1 or S phase with doses up to 700 rads, demonstrated no anomalous behavior, either in the initiation or duration of semiconservative DNA replication. These data suggest that, in terms of cellular kinetics, ionizing radiation-induced progression delays (during the initial generation) occur only in G_1 and G_2 phase, while the duration of S phase is unaffected. (auth)

678 RNA-DNA COVALENT COMPLEXES IN HeLa CELLS. Neubort, S.; Bases, R. (Yeshiva Univ., New York). Biochim. Biophys. Acta; 340: No. 1, 31-39(Feb 1974).

A (5-^{3}H)uridine-labeled ribonuclease-resistant RNA-DNA complex was isolated from pulse-labeled HeLa cells. Analysis in Cs_2SO_4 density gradients showed that radioactive label in both the native and the denatured complexes banded at buoyant densities typical of DNA. The complexes consisted of short ribonuclease H sensitive ribonucleopolymer chains covalently attached to much longer strands of newly synthesized DNA. The hybrid was hydrogen bonded to the template DNA. The rate of synthesis of the complex in synchronized cultures temporally paralleled the rate of DNA synthesis in cells traversing S phase. Cells arrested in G-2, 24h after x-irradiation with 1000 rads, synthesized the complex at only 1/6th of the rate found in unirradiated cells. With cells in G-1 and early S phase 1000 rads depressed synthesis of the complex by 36%. A role for the complex in the initiation of DNA synthesis in animal cells is suggested. (NL)

679 COOPERATION AND CELL-MEDIATED CYTOTOXICITY AS FUNCTIONS OF TWO SUBSETS OF T CELLS. Dennert, G.; Lennox, E. S. (Armand Hammer Center for Cancer Biology, San Diego, CA). J. Immunol.; 113: No. 5, 1553-1561(Nov 1974).

After stimulation of mice with alloantigens the ability of their spleen cells to effect cell-mediated cytotoxicity and to assist in the triggering of bone marrow-derived lymphocytes were compared using the DBA/2 mastocytoma, P815, as allogeneic immunogen on the one hand and as target for cytotoxicity and carrier for hapten on the other. Spleen cells from animals immunized with either low doses of irradiated or formaldehyde-treated P815 cells exhibit cooperating activity but not cytotoxic activity. In addition, it is shown that spleen cells from C57BL/6 mice immunized with P815 do contain cytotoxic thymus-derived (T) lymphocytes but are unable to trigger bone marrow-derived cells for a hapten response in vitro to hapten-coupled P815 antigen. That there may be some helper cells in cytotoxic spleens is not excluded, for it is shown that mixing cytotoxic spleens with those showing helper function blocks the expression of that helper function. Both functions, helping and killing, are sensitive to anti-θ serum, and it is concluded that they are carried out by two different subsets of T cells. (auth)

680 EFFECT OF LOW VALUES OF ABSORBED DOSES OF ALPHA RADIATION ON THE GROWTH OF NORMAL FIBROBLASTS IN PRIMARY CULTURE. Dobrachev, Yu. P. Vop. Kurortol., Fizioter. Lech. Fiz. Kul't.; 38: No. 1, 48-51(1973). (In Russian).

The addition in the nutrient medium of tissue cultures of radon at concentrations from 9.1×10^{-4} to 3.6×10^{-1} μCi/ml, during which the absorbed dose does not exceed 1 rad, stimulates the division of cells (up to 140 to 160% over that of the controls) because of the division of cells of all dimensions. The maximum increase of the number of cells was observed at doses of 0.01 to 0.3 rad, absorbed during the cell cycle. The number of dead cells in the culture either decreases or is unchanged. Doses above 10 rad absorbed during the cell cycle lead to depression of the growth of the tissue culture and significantly increases the number of dead cells in primary cultures of embryonic fibroblasts of the rat. (tr-auth)

681 INFLUENCE OF 5-BROMODEOXYURIDINE ON DNA REPAIR IN CHINESE HAMSTER CELLS EXPOSED TO ULTRAVIOLET RADIATION. Rommelaere, J.; Cornelis, J. J.; Miller-Faures, A.; Errera, M. (Univ. Libre, Brussels). Biochim. Biophys. Acta; 340: 388-399(1974).

The kinetics and dose dependence were determined both for the repair synthesis and for the induction and repair of single-strand breaks in the 5-bromodeoxyuridine-substituted DNA of ultraviolet-irradiated Chinese hamster cells. A close temporal relationship was observed between repair synthesis and break sealing. The induction of single-strand breaks was linear with dose, whereas a non-linear response was found for repair synthesis. Since almost all breaks were repaired, the calculated number of bases which could be inserted per repaired single-strand break depended on the dose and was close or inferior to a hundred. (auth)

682 TEMPORAL RELATIONSHIP BETWEEN NON-HISTONE PROTEIN SYNTHESIS AND DNA REPLICATION IN NORMAL AND IRRADIATED MAMMALIAN CELLS. Gerner, E. W. Austin, TX; Univ. of Texas (1974). 163p. University microfilms order No. 74-21,352.

Thesis (Ph. D.).

The kinetics of non-histone protein synthesis and semiconservative DNA replication were studied in synchronous populations of normal and irradiated Chinese hamster ovary cells. Semiconservative replication kinetics were monitored by isopynic centrifugation of DNA containing density-labeled daughter strands. The proportion of DNA replicated was determined by measuring the amount of DNA that acquired hybrid buoyant density in CsCl gradients. The kinetics of nonhistone protein synthesis were determined by pulse labeling cells with ^{3}H-leucine at various times throughout the cell cycle. Radioactivity was assayed following chemical fractionation to obtain chromatin material. Although non-histone proteins were synthesized in all phases of the cell cycle studied, non-histone synthesis was 3- to 5-fold higher in late G_1 phase when compared to any other phase. Chinese hamster ovary cells irradiated during mitosis or early G_1 exhibited a 0.5-hour, dose-independent (150-700 rads) delay in the initiation of

semi-conservative DNA replication. Once initiated, the kinetics of DNA replication were unaffected in these populations. As cells moved from early G_1 to late G_1, ionizing radiation effects on the initiation of DNA replication disappeared. Cells irradiated in late G_1 or S phase with doses up to 700 rads demonstrated no anomalous behavior, either in the initiation or duration of semi-conservative DNA replication. Similarly, non-histone protein synthesis rates, for cells irradiated in mitosis with 300 rads, were depressed as these cells entered late G_1 and reached their maximum value approximately 0.5 hours after the unirradiated controls. These data indicated that the temporal coordination between non-histone protein synthesis and DNA replication observed in normal Chinese hamster ovary cells is conserved in irradiated populations. In order to test whether damage to the DNA of mitotic or early G_1 cells might account for the G_1 progression delay observed in x-irradiated cells, 5-bromodeoxyuridine substituted cells were irradiated in mitosis or early G_1 with fluorescent light. Using survival levels similar to those resulting from 300 rads of ionizing radiation (3-4%), it was found that BUdR substituted mitotic or early G_1 cells irradiated with fluorescent light undergo a G_1 progression delay of the same magnitude as that induced by ionizing radiation. These data suggest that, while ionizing radiation has no effect on the kinetics of semi-conservative DNA replication, it can affect specific steps leading to the initiation of replication. DNA damage, resulting from the irradiation, may have to be repaired before transcription can occur leading to factors required for the initiation of S phase. (Diss. Abstr. Int., B)

683 X-RAY INACTIVATION OF CULTURED MAMMALIAN CELLS: ENHANCEMENT BY ULTRASOUND. Todd, P.; Schroy, C. B. (Pennsylvania State Univ., University Park). Radiology; 113: No. 2, 445-447(Nov 1974).

Ultrasound (0.14 W/cm^2, 920 kHz) was found to decrease the dose of 50-kVp x rays required to prevent 99% of cultured M3-1 Chinese hamster cells from forming colonies by a factor of 1.3 when delivered during the first 10 minutes after irradiation. Ultrasound alone had no detectable effect. Postirradiation heating for 10 minutes at the maximum temperature tolerated by the cells (42°C) had no detectable effect on radiation dose-survival curves. (auth)

Radiation Effects on Microorganisms

684 (COO-3482-21) RADIATION LETHALITY IN ESCHERICHIA COLI. Gersten, D. (State Univ. of New York, Buffalo (USA)). May 1973. 83p. Dep. NTIS $7.25.

Thesis.

Survival, post-irradiation DNA degradation, and ability of hosts to excise pyrimidine dimers from phage T7 as a function of dose were studied in four strains of the B series of E. coli following x and uv irradiation. It was found that the contribution to radioresistance of the three controlling loci by which the strains differ are additive both at the gross survival and dimer excision levels. The ability of hosts to excise dimers is not destroyed as a function of dose, indicating that ultimate lethality in this series of bacteria is due to a presentation of more damage to the cell than its repair system can restore. The implications of this are discussed. (auth)

685 ELECTRON AFFINIC SENSITIZATION. V. Radiosensitization of Hypoxic Bacteria and Mammalian Cells in Vitro by Some Nitroimidazoles and Nitropyrazoles. Asquith, J. C.; Watts, M. E.; Patel, K.; Smithen, C. E.; Adams, G. E. (Mount Vernon Hospital, Northwood, Eng.). Radiat. Res.; 60: No. 1, 108-118(Oct 1974).

Five nitro-substituted imidazoles and three nitro-substituted pyrazoles were investigated as radiosensitizers for hypoxic mammalian cells cultured and irradiated in vitro. All the compounds sensitize, but the pyrazoles are less effective than the imidazoles. There is no sensitization of cells irradiated in the presence of oxygen. One of the two 2-nitroimidazoles, Ro-07-0582, is much more effective than any of the other compounds and shows a large degree of sensitization in the submillimolar range. At 4 mM concn, the enhancement ratio is about 2.5 which is near the value for the oxygen enhancement ratio for these cells. The cytotoxicity of this sensitizer is low and the sensitizing properties are not diminished by increasing the protein concentration of the medium. The maximum enhancement ratio for this sensitizer is independent of the position of the cells in the mitotic cycle. (auth)

686 DEPRESSION OF HUMAN MONOCYTE CHEMOTAXIS BY HERPES SIMPLEX AND INFLUENZA VIRUSES. Kleinerman, E.; Snyderman, R.; Daniels, C. A. (Duke Univ., Durham, NC). J. Immunol.; 113: No. 5, 1562-1567(Nov 1974).

To determine the effect of virus infection on monocyte chemotaxis, mononuclear leukocytes (MNL) were isolated from human peripheral blood on a Ficoll-Hypaque gradient and the chemotactic responsiveness was quantitated in modified Boyden chambers. The MNL were exposed to herpes simplex (7 plaque-forming units/MNL) or influenza virus ($10^{3.0}$ hemagglutinin units/$10^{6.7}$ MNL) before quantification of chemotactic responsiveness of the cells to a chemotactic lymphokine. Incubation of these viruses with human MNL depressed monocyte chemotaxis by 62 to 85% ($p < 0.001$) as compared to MNL incubated with non-infectious (uv-irradiated) viruses or a control tissue culture preparation. Similar amounts of vaccinia, polio, and reovirus were not inhibitory, and suggested that the inhibition was not a universal effect of viruses. Depressed chemotaxis was not caused by virus-induced cytotoxicity (as measured by trypan blue exclusion) since greater than 95% of the MNL were viable at the end of the assay period. The data suggest that one mechanism for the depression of cell-mediated immunity seen in certain viral infections can be due to the ability of viruses to inhibit monocyte chemotactic responsiveness. (auth)

687 GEOMICROBIOLOGICAL STUDIES. XII. Behavior of Microorganisms on Uranium-Containing Rocks. Ebner, H. G.; Schwartz, W. (Inst. for Molecular Biology Research, Brunswick). Z. Allg. Mikrobiol.; 14: No. 2, 93-102(1974). (In German).

Thiobacillus ferrooxidans and Thiobacillus thiooxidans were among the most highly uranium-tolerant microorganisms found on uranium containing rocks in the German Federal Republic. The uranium content of the rocks varied between 0.027 and 5.8 percent. The Thiobacillus strains were generally found on rocks with low pH. The rocks also held a variety of fungi and bacteria; the germ count generally decreased with increasing leachable uranium concentration in the rock. Maximum Thiobacillus concentrations encountered were 12.5 g U/liter for thiooxidans and 1 g U/liter for ferrooxidans. Any heavy metal content in the rock does not act synergistically with the uranium. There was some evidence of adaptation of the microorganisms to uranium. (JPRS)

688 ELECTRON MICROSCOPY STUDY OF THE AORTIC VALVE ALLO- AND XENOTRANSPLANTS FOLLOWING THEIR PROLONGED FUNCTIONING IN THE HUMAN HEART. Yaroshinskii, Yu. N.; Shekhter, A. B.; Artyukhina, T. V.; Glagoleva, E. V.; Fursov, B. A. (Inst. of Cardiovascular Surgery, Moscow). Byull. Eksp. Biol. Med.; 78: No. 9, 116-119(Sep 1974). (In Russian).

The aortic valve allo- and xenotransplants were examined by electron microscopy following chemical sterilization and gamma irradiation conducted by different methods. Ultrastructural components in the cells of the aortic transplants proved to change after chemical sterilization and were intact following gamma irradiation. Dynamic development of specific processes in the destruction of the connective tissue of the valve was revealed under conditions of prolonged transplant functioning in the human heart. Destruction of collagen was not related to its fermentative destruction, but was caused by passive mechanical damage. (auth)

689 EFFECT OF IRRADIATION ON TRANSDUCTION AND LYSOGENIZATION IN SALMONELLA TYPHIMURIUM. Polasa, H.; Plough, H. H. (Amherst Coll., MA). Curr. Sci. (India); 43: No. 20, 638-640(20 Oct 1974).

Irradiation of either temperate Phage 547 of Salmonella or recipient cells increases the frequency of transduction whereas lysogenization decreases. The increase in transduction is due to the stimulating effect of the irradiation on recombination and loss of lytic action of the phage. The irradiation results suggest that the whole phage genome is more radiosensitive than the transducing fragment. (auth)

690 REPAIR OF RADIATION-INDUCED DNA BREAKS IN HUMAN ADENOVIRUS. Rainbow, A. J. (McMaster Univ., Hamilton, Ont.). Radiat. Res.; 60: No. 1, 155-164(Oct 1974).

A repair of single-strand DNA breaks was detected in irradiated adenovirus following the infection of human cells. Adenovirus type 2 was given graded doses of cobalt-60 gamma rays at -75°C and subsequently used to infect human KB cells at approximately 100 PFU (original)/cell. The viral DNA was then assayed for single-strand breakage on alkaline sucrose gradients before, and at various times after, infection. The number of DNA molecules with no single-strand breaks increased after infection reaching a maximum fraction of whole molecules about 25 hr after infection. The rate of increase in the fraction of whole DNA molecules was enhanced at a lower input multiplicity of 25 PFU/cell and reduced at a higher input multiplicity of 250 PFU/cell. The maximum fraction of whole molecules obtained after infection coincides with the survival of the plaque forming ability of the virus and suggests that the repair of single-strand breaks leads to restoration of the biological expression of the viral DNA. (auth)

691 RADIOSTERILIZATION OF MEDICAL MATERIALS AND THE RADIOPRESERVATION OF FOOD. Eymery, R. (CEN, Grenoble, France). Sci. Tech. (Paris); No. 11, 32-37(15 Feb 1974). (In French).

From meeting on the consequences of the nuclear technique developments on the daily activity of engineers; Paris, France (20 Nov 1973).

The interaction of primary particles (accelerated photons or electrons) with matter manifests itself primarily as the appearance of high-speed secondary electrons in the bombarded medium. It was discovered experimentally that the energy of ionization given off by the totality of the particles leads to the destruction of microorganisms without inducing radioactivity. The use of this technique has permitted presenting the question of guaranteeing sterility in precise terms. Many radiotreatment installations are now in operation: a brief description is given. (FR)

692 EFFECT OF CYCLIC AMP AND SOME STRUCTURAL ANALOGUES ON THE DARK REPAIR INHIBITION BY CAFFEINE OF UV-IRRADIATED CELLS. Chandra, P.; Scheckel, R. E. O.; Wacker, A. (Univ., Frankfurt am Main). Radiat. Environ. Biophys.; 11: 87-90(29 Mar 1974).

The effect of cyclic AMP and some structural analogues on the dark-repair inhibition by caffeine has been studied. Cyclic AMP had no significant effect, contrary to the previous report by Wacker et. al. [5], on the dark-repair inhibition by caffeine. Some cyclic AMP derivatives, resistant to hydrolysis by the phosphodiesterase enzyme, were used to investigate the role of phosphodiesterase in dark-repair inhibition by caffeine. These derivatives, when added alone, had no activity on the dark-repair process. Experiments in combination with caffeine showed that these derivatives were unable to reverse the dark-repair inhibition by caffeine. The present data do not support any correlation between the caffeine inhibition of the dark-repair process, and the phosphodiesterase involved in cyclic AMP metabolism. (auth)

693 METABOLISM OF PHOSPHORUS-CONTAINING COMPOUNDS IN MOLD FUNGI UNDER THE ACTION OF VISIBLE LIGHT AND ULTRAVIOLET RAYS. Zemlyanukhin, A. A.; Chebotarev, L. N. (Voronezh State Univ., USSR). Biol. Nauki; No. 12, 48-52 (1973). (In Russian).

The effect of visible light of different wavelengths and of ultraviolet rays of 70 $\mu W/cm^2$ intensity acting for 20 min. on the pigmented molds Botrytis cinerea, Penicillium glaucum, and P. roqueforti and on the nonpigmented P. candidum was studied. Ultraviolet radiation decreased the ATP content of the mycelium cells, in which process ATP-ase participates. Shortwave visible light increased the contents of ATP and of phosphorylated derivatives of hydrocarbon decay products, while uv radiation accelerated the restoration of the ratio between the organic and mineral phosphates. Pigmented molds were less sensitive to uv radiation and took part in the restoration of function of the phosphorylation system. (tr-auth)

694 LEISHMANIA ENRIETTII: RADIATION EFFECTS AND EVALUATION OF RADIOATTENUATED ORGANISMS FOR VACCINATION. Lemma, A.; Cole, L. (Stanford Research Inst., Menlo Park, CA). Exp. Parasitol.; 35: 161-169(1974).

The effects of gamma radiation and ultraviolet light on motility, morphology, reproduction, ability to transform from amastigote to promastigote, infectivity, and vaccine potential of Leishmania enriettii were studied. Over 800,000 roentgens (R) was necessary to immobilize immediately the organisms, whereas only 25,000 R rendered them noninfective and 50,000 R made amastigotes unable to transform to promastigotes. Increasing degrees of morphological abnormality were seen with increased radiation doses. Single, double, and triple vaccination with 25,000 to 100,000 R irradiated organisms had no protective value against L. enriettii. (auth)

Radiation Effects on Plants

Refer also to abstracts 661 and 765.

695 (AED-CONF-73-430-012) ENDOCELLULAR REGULATION OF CELL PROLIFERATION AND CELL DIFFERENTIATION. von Wangenheim, K. H. (Kernforschungsanlage Juelich G. m. b. H. (F. R. Germany). Inst. fuer Botanik und Mikrobiologie). 1973. 5p. (In German). (CONF-7309120-2).

From annual meeting of the Deutsche Gesellschaft fuer Biophysik; Juelich, F. R. Germany (27 Sep 1973).

Radiobiological investigations of plants showed that the damage to proliferating tissue due to irradiation is not only caused by irreversible genetic defects, but rather by the induction of a 'premature differentiation'. This is also true for animal tissues. The process described by the term 'premature differentiation' is a reduction of the number of mitotic cycles normally experienced by intermediate cell types and following types before these are able to differentiate to functional cells. This process is due to the fact that during radioinduced delay of mitosis, multiplication processes continue unhindered in the cytoplasm, including multiplication of autoreduplication cytoplasmic constituents, which causes an increase in the quantitative ratio of cytoplasm to cell nuclei. Other experiments with non-irradiated plant endosperm have shown that in this case, too, enhancement of this ratio reduces the number of mitotic cycles, whereas this number is increased by reducing the ratio. From these results it can be concluded that the quantitative ratio of cytoplasm amount (number of autoreduplicating constituents) to the ploidy of the cell nuclei plays an important part in the regulation of the mitotic activity of higher, multicellular organisms. Contrary to earlier assumptions (nuclei-plasma-tension), enhancement of this ratio above certain levels does not induce mitosis but rather differentiation and termination of mitotic activity. (GE)

696 IMPROVEMENT IN QUALITY CHARACTERISTICS AND YIELD ATTRIBUTES THROUGH GAMMA-IRRADIATION IN RICE (ORYZA SATIVA L.). Govindaswami, S.; Ghosh, A. K.; Misra, R. N. Indian J. Agr. Sci.; 42: No. 10, 869-872(1972).

A hybrid rice culture CR 75-93 was treated with 15, 25, and 35 KR of gamma rays to improve its yield attributes and cooking quality. Out of a large number of mutants affecting several morphological characters isolated at M_2 and further tested at M_3, 7 mutants were found to be quite promising. These had long slender grains, better cooking quality, and higher single-plant yield than the control variety. (Indian Sci. Abstr.)

697 EFFECTS OF RECURRENT IRRADIATION ON ROOT-TIP ANAPHASE IN LATHYRUS SATIVUS L. AND HORDEUM VULGARE L. Das, A. (Bose Inst., Calcutta). Trans. Bose Res. Inst. (Calcutta); 35: No. 3-4, 55-60(1972).

One of the important problems of plant radiobiology is the wide range of sensitivity of different plant species to ionizing radiation. Mutagenic activity of recurrent irradiation from x rays on two plant species viz. Lathyrus sativus L. and Hordeum vulgare L. relating the root-tip anaphase division of chromosomes was studied. (auth)

698 RADIOBIOLOGICAL STUDIES ON THE EFFECTS OF GAMMA IRRADIATION ON BARLEY VAR. K12. Goswami, B. C. (Gauhati Univ., India). J. Assam Sci. Soc.; 15: No. 2, 144-149 (1972).

Dry barley seeds of variety K12 were irradiated with 5 doses of 10, 15, 20, 25, and 30 kr gamma rays. Irradiated and check seeds were germinated in the lab and also space planted in the field. While there was no difference in germination due to different doses under lab conditions, germinations and survival of seedlings decreased in a linear manner in the field with increase of radiation doses. However, survival of seedlings on the basis of seeds germinated was higher at higher doses. Pollen and ovule sterility in the M_1 plants was higher at higher doses and showed a linear relationship. The frequency of single chromosome interchange analyzed in M_1 showed linear increase with dose. (Indian Sci. Abstr.)

699 VTORZHENIE V KLETKU (RADIATSIYA I SELEKTSIYA RASTENII). Cytogenetic Aspects of Plant Selection by Means of Radioinduced Mutations. Tarasenko, N. D. Moscow; Atomizdat (1974). 88p.

The use of radiation in the production of new, high yield, early ripening varieties of agricultural plants from radio-induced mutations is discussed in detail and in an easily understood fashion. (JSR)

700 INDUCED VIABLE MUTATIONS IN CORCHORUS OLITORIUS L. Thakare, R. G.; Joshua, D. C.; Rao, N. S. (Bhabha Atomic Research Centre, Bombay). Indian J. Genet. Plant Breed.; 33: No. 2, 204-228(Jul 1973).

One hundred and thirty six viable mutations of Corchorus olitorius induced with gamma rays, thermal and pile neutrons were classified and described. The meiosis of all these mutants were studied and were found to be normal. By far, leaf mutations were more in our collection. Some of the mutations were drastic with completely altered morphology exhibiting transgeneric and transspecific variations. Such mutations could either be due to the pleiotropic action of a gene or to cryptic chromosome deletions. Thermal neutrons were found to be 1.5 times more effective than gamma rays in inducing viable mutations. (auth)

701 CYTOGENETICAL EFFECTS OF PHYSICAL AND CHEMICAL MUTAGENS IN RICE. Siddiq, E. A. (Indian Agri-

cultural Research Inst., New Delhi). Indian J. Genet. Plant Breed.; 33: No. 2, 162-171 (Jul 1973).

Relative effects of physical and chemical mutagens with respect to the cytological behavior and pollen sterility in two varieties representing indica and japonica of Oryza sativa were assessed. The study, in general, revealed that the japonica variety was more sensitive to mutagens than the indica variety. Occurrence of rare cytological anomalies has also been reported. (auth)

702 INDUCED MUTATION FREQUENCY AND SEGREGATION RATIOS AMONG TILLERING SYSTEMS IN RICE. Nair, N. K.; Ninan, C. A. Indian Soc. Nucl. Tech. Agr. Biol., Newslett.; 2: No. 1, 33-35 (1973).

The variability for number of productive tillers per plant was studied in M_2 populations of gamma (^{60}Co) irradiated 10, 20, and 30 KR) rice variety Jaya. Progenies of 3352 M_1 spikes, totalling to 35,691 M_2 plants were analyzed. The effect of gamma rays on tillering systems, grouped as monoculm, low tillering, medium tillering, high tillering, and profuse tillering, was studied in detail. The mean number of tillers per plant was found to increase with increase in dose level from 10 to 30 KR without significant alteration in the mean value from control. The variance for tiller number was greater in the irradiated material compared to controls and falls in negative and positive directions with equal frequency. A high frequency of monoculm mutants was observed in 10 KR treated plants and profuse tillering mutants in greater frequencies in 30 KR treatments. (Indian Sci. Abstr.)

703 IRRADIATION OF PLANTS IN DIFFERENT PERIODS OF ONTOGENESIS. Batygin, N. F. pp 42-45 of Primenenie Izotopov i Yadernykh Izluchenii v Sel'skom Khozyaistve. I. Moscow; Atomizdat (1971). (In Russian)

In 1928, studies were started on morphological and biochemical changes in plants due to irradiation at different periods of ontogenesis. Irradiation in stage II, when sprouts are forming, and in stages V and VI, when sprouts are growing, may have similar results. In cultures with sympodial type of branching, growth and other processes were inhibited. Irradiation in early stages interfered with stem growth. Increase in harvest was noted when the irradiation was during the period of formation of large buds. Irradiation at some stages of ontogenesis activated metabolic processes. Moderate radiation doses increased the content of some substances. A practical recommendation is irradiation of vegetable seedlings. The nature of the reaction of plants to irradiation and the obtaining of favorable results depend largely on the conditions of cultivation. (INIS)

704 DYNAMICS OF BIOLOGICAL RADIATION EFFECT MANIFESTATION. Riza-Zade, R. R.; Suleimanova, N. D. pp 70-77 of Primenenie Izotopov i Yadernykh Izluchenii v Sel'skom Khozyaistve. I. Moscow; Atomizdat (1971). (In Russian)

Studies were made on Armavirski 3497 sunflowers under laboratory and field conditions, gamma irradiated with a stimulating, 2-kR, dose and an inhibiting, 20-kR, dose (740 R/min). Results are reported of the calculation of the dynamics of plant development during the vegetative period, from the beginning of setting of the calathides to maturity. Radiobiological effects of presowing irradiation of sunflower seeds are shown. In the 2-kR group there was accelerated growth and development. The plants weighed more, had a larger number and photosynthetic area of the leaves, and heavier and larger diameter roots. The reverse was true in the 20-kR group. In the interphase period of growth of both irradiated and control plants the radiobiological effect tended to be attenuated. The attenuation was not an absence of effect but rather an external, difficultly perceptible qualitative preparation of the organism for quantitative expression in a new, ontogenetically higher phase of development. (INIS)

705 IONIZING RADIATION APPLICATION IN THE PROCESS OF COTTON PLANT HYBRIDIZATION. Gulamov, M. K.; Atazhanov, M.; Narimov, S. pp 24-30 of Primenenie Izotopov i Yadernykh Izluchenii v Sel'skom Khozyaistve. I. Moscow; Atomizdat (1971). (In Russian).

The action of ionizing radiation on cotton seedlings was studied. Observations on the growth and development of plants, hybridological analysis, consideration of productivity, and determination of basic agricultural economic indexes were made. Pollen was found very sensitive to the action of ionizing radiation. The optimum gamma dose is 1.6 to 1.8 kR. Studies on irradiated and nonirradiated seedlings extended to the third generation showed that irradiated seedlings showed the greatest variety of forms. Second generation seedlings, obtained by crossing mutants with productive types, sometimes showed original traits. This was observed with regard to type of branching, presence of lint on the seed, and gymnospermnicity in the F_2 seedlings. (INIS)

706 PROSPECTS FOR RADIATION USING FOR GROWTH, DEVELOPMENT, AND PRODUCTION STIMULATION OF VALUABLE RADIOMUTANTS OF COTTON PLANTS. Ibragimov, Sh. I.; Koval'chuk, R. I. pp 13-17 of Primenenie Izotopov i Yadernykh Izluchenii v Sel'skom Khozyaistve. I. Moscow; Atomizdat (1971). (In Russian)

At the USSR Institute for Experimental Biology and at the Institute for Cotton Selection and Seed Growing, studies were made on the use of radiation in cotton production: (1) irradiation of seeds to stimulate growth, development and productivity, and (2) irradiation of growing plants to produce mutants with properties valuable in agriculture. Data obtained at laboratories and experiment stations indicated that irradiation of cotton seed (108-F) with 1000 and 2000 R increased the harvest 2.0 to 2.2 hundredweight per hectare. In a single irradiation of a growing plant there was a favorable effect from irradiation in the whole bud, flower, zygote, and proembryonic stages. Doses of 2000 R were optimum in the budding phase and 500 and 2000 R in the flowering phase. This method can be used to compare types in a short time. (INIS)

707 PROBLEM OF RADIOSENSITIVITY AND POSSIBILITY OF γ-RADIATION APPLICATION IN CROP SCIENCE. Zezyulinskii, V. M. pp 33-41 of Primenenie Izotopov i Yadernykh Izluchenii v Sel'skom Khozyaistve. I. Moscow; Atomizdat (1971). (In Russian)

Field and growth experiments on various agricultural crop plants were made in a gamma (^{60}Co) field. The radiation sensitivity of plants to chronic and to single irradiations was studied in daily irradiations for 18 hr/day, in which growth depressing and stimulating doses were determined. The radiation sensitivity of most species was about the same for irradiation of dry seeds or growing plants. The sensitivity to presowing irradiation of vegetative organs of reproduction (bulbs, tubers) was greater than that of dry seeds. The sensitivity of barley, beans, and sunflowers decreased as a function of the stage of organogenesis. The method of irradiating growing plants according to the growth phase may be used for inducing favorable mutations. (INIS)

708 STUDIES ON 31 CYANOPHYTA SPECIES. I. Amino Acid Analyses. II. Effects of Irradiation with ^{60}Co. Thompson, J. B. Houston, TX; Univ. of Houston (1974). 170p. University Microfilms Order No. 74-21,400.

Thesis (Ph. D.).

Complete amino acid analyses of 20 species of blue-green algae were done after growing part of the cultures axenically. A Beckman Model 121 Automatic Amino Acid Analyzer was used at NASA. Amino acid analyses of the representative species needed could not be located with a Medlars Search in the literature, hence the cultures had to be grown, lyophilized, and chemically purified for the amino acid analyses. To test the most self-sufficient cells known, the blue-green algae, 26 species, under simulated conditions of the Mars Mission in 1975 were irradiated with ^{60}Co from two sources, the nuclear reactor at Texas A & M, and the therapeutic X-ray machine at Baylor University School of Medicine. The irradiated sealed cultures were left under a double seal, unopened for 10 months (approximate time for a space ship to reach Mars), then placed in nutrient broth under proper conditions for growth. Controls were run. There was a single survivor, Glaucocystis nostochinearum, the single symbiont in the group, indicated there is a possibility that earth organisms could contaminate Mars. The theory of Symbiosis for the origin of the eucaryotic cell from the procaryotic cell is also supported. (Diss. Abstr. Int., B)

Radiation Effects on Animals

Refer also to abstract 658.

Man

Refer also to abstracts 508–512, 523, 526, 530, 821, 825–830, 836, 837, 845, 2227, 2242, 2244, 2599, and 2604.

709 (AED-CONF-73-546-009) RADIATION PROTECTION DEVICES AND THEIR APPLICATION. Baeuml, A.; Widenmann, L. (Bundesgesundheitsamt, Neuherberg/Muenchen (F. R. Germany). Abt. fuer Strahlenhygiene; Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany)). 1973. 13p. (In German). (CONF-731150-1).

From 14th annual meeting of the Vereinigung Deutscher Strahlenschutzaerzte; Wuerzburg, F. R. Germany (16 Nov 1973).

Technical means are considered to reduce the radiation dose such as shielding devices (lead rubber plates, protective aprons, devices for the protection of the ovaries and testes, protective walls and platforms), further with various apparatuses for reducing and controlling the radiation exposure (e.g. protective tube

housing, tubes, filter, diaphragms, fluoroscope timers, dosimeters, and holding devices) and with detector systems which can be used to reduce the required dose (such as intensifying screens, combined with highly sensitive film material, optimum film treatment, image-intensifier-fluoroscopy by television including image recording and storage on magnetic tape). According to paragraph 12 of the x-ray Ordinance, the radiation dose to the patient has to be kept as low as possible, and it is generally accepted that the lower the dose to the patient, the lower the emission of parasitic x-rays which may affect the medical personnel. The most effective measure to reduce the integral dose is the proper dimensioning of the field size, particularly in the case of fluoroscopic examinations. Full-size x-rays should be replaced by radiograms taken with the aid of image intensifiers and television cameras, which can lead to a reduction to 1/20 up to 1/100. The required minimum radiation protection equipment depends on the type of the x-ray devices and on the scope of operation so that there is no standard equipment to be recommended or required. (GE)

710 (CONF-741018-, pp 9-16) USE AND MISUSE OF POPULATION EXPOSURES IN RADIATION PROTECTION. Tompkins, P. C. (Environmental Protection Agency, Research Triangle Park, NC). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population Exposures.

Methods of evaluating population exposures are clarified, and uses of the data by such groups as the ICRP, NCRP, and FRC in radiation protection and by the NAS and UNSCEAR for evaluation of risk to populations are discussed. The following topics are discussed: radiation protection dogmas; radiation risk assumptions; dose commitment; and person rem concept in radiation protection. (HLW)

711 (CONF-741018-, pp 23-28) DATA NEEDS FOR THE ASSESSMENT OF POPULATION DOSE FROM BACKGROUND RADIATION. Lowder, W. M.; Harley, J. H.; McLaughlin, J. E. (Health and Safety Lab., New York). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population Exposures.

In the course of preparation of two NCRP reports on the dose to the U. S. population from background radiation and on techniques of measurement, several significant sources of uncertainty were identified that are relevant to all studies of human population exposure to this background. These include the extremely limited data on gamma radiation and airborne radon levels in the indoor environment and their dependences on the properties and radionuclide contents of building materials; possible inadequacies in the models used to relate radiation or radionuclide measurements to human organ dose; and possible uncertainties in the dose contributions of cosmic ray charged particles (~10%). In addition, the need for considerably more detailed information on the time variations of the various components of background radiation is relevant to the quantitative assessment of small additions to the overall radiation exposure produced by manmade radionuclides in the environment. These considerations become more critical when realistic population dose estimates are desired for a limited geographic region, particularly a highly urbanized area. In most such situations, reasonably extensive measurement programs would be required. Existing information on typical radionuclide distributions, radiation fields, and component doses such as are contained in forthcoming NCRP reports would provide useful guidance in the design of such programs. (auth)

712 (CONF-741018-, pp 79-88) POPULATION EXPOSURE FROM DIAGNOSTIC X RAYS AND THEIR CONTROL. Villforth, J. C. (Bureau of Radiological Health, Rockville, MD). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population Exposures.

Unnecessary radiation from diagnostic x rays is the largest part of exposure to manmade radiation. Radiology is one of the more useful diagnostic tools available to the clinicians, and the rate of its use has increased in excess of the rate of population increase. Of more marked significance is the greater number of films per procedure and the higher exposure per abdominal film in 1970 compared to 1964. This increase occurred in spite of the considerable efforts of the state radiation control programs to correct inadequacies of equipment. By June, 1973, 83 percent of all dental x-ray machines and 50 percent of all medical machines were in compliance. The nationwide evaluation of x-ray trends (NEXT) data indicates the spread of exposure distribution for various procedures. The unnecessary exposures in dental radiology are the result of slow speed film, low kVp, and improper processing. Using a dental exposure normalization technique, one state was able to reduce dental exposures to one-fifth of the former values. Medical x-ray exposures are similarly affected. Education and motivation of the users continue to be important elements of a control program along with equipment improvements. The Federal diagnostic x-ray equipment performance standard was effective August 1, 1974, and will require positive beam limitation on all new units. Twenty different defect actions have been taken against unacceptable medical and dental machines manufactured after October 1968. Over 14,940 different machines have been repaired under the defect provision of P.L. 90-602. The need for the health physicist to continue his interest in reducing the unnecessary component of x rays in the healing arts is emphasized. (auth)

713 (CONF-741018-, pp 89-98) MATHEMATICAL MODEL FOR ESTABLISHING THE BENEFIT VS RISK CRITERION ON DIAGNOSTIC RADIOLOGY. Port, E. A.; Cember, H. Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population Exposures.

A quantitative evaluation of benefit and risk can lead to a substantial reduction in population exposure from diagnostic radiology. The development and application of a decision theory model for radiological procedures are described. A multistage decision model was constructed with payoff matrices and experimental costs based on medical judgment. Conditional probabilities are continually updated to keep pace with changing conditions. The model can be applied by any physician who has access to relatively low-powered computer facilities; and can be used to determine whether a specific radiological procedure is clinically indicated. The structure of the model, the evaluation of parameters and an application pertinent to pediatric radiology are given. (auth)

714 (CONF-741018, pp 111-120) PATIENT EXPOSURE FROM SPINE, CHEST, AND DENTAL X-RAYS: A PARTIAL ANALYSIS OF THE "NEXT" DATA. Cameron, J. R. (Univ. of Wisconsin, Madison); Wochos, J.; Wilson, C. R. Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population Exposures.

The National Evaluation of X-Ray Trends (NEXT) program obtained data on the physical factors related to patient radiation exposure from various standard diagnostic radiology examinations. The data for lumbar-sacral spine, chest and dental bitewing posterior radiographs were examined for significant differences in the exposure, beam area/film area and exposure area product delivered to a "standard patient" for different types of facilities and operators. The exposure area product is reported in "raps", where 1 rap = 100 R cm. For lumbar-sacral spine radiographs (N = 236) general practitioners' facilities gave 25% more exposure than other groups ($p \leq 0.025$). Chiropractic, orthopedic and general practitioners' facilities gave significantly greater raps than others ($p \leq 0.05$). For this procedure trained x-ray technologists delivered significantly lower raps than practitioner operators ($p \leq 0.005$). For P-A chest radiographs (N = 560) general practitioners' facilities delivered significantly greater raps than most other facilities ($p \leq 0.05$). Practitioner operators delivered significantly less exposure than trained technologists ($p \leq 0.025$), but trained technologists gave significantly lower raps than both practitioner operators and operators with no training ($p \leq 0.025$). For dental bitewing posterior radiographs (N = 533) certified dental assistants delivered approximately 30% higher exposure than other operator groups. Kilovoltage was found to be negatively correlated to exposure for lumbar-sacral spine and dental bitewing posterior radiographs, and positively correlated to exposure for chest radiographs. The measured mR/mAs was compared to a value calculated from the reported kVp and HVL for each of the radiographic studies. (auth)

715 (CONF-741018-, pp 143-150) GONADAL AND FETAL DOSES FROM RADIATION THERAPY OF HODGKIN'S DISEASE WITH A 6MV LINAC. Combine, T.; Bukovitz, A. G. (Univ. of Pittsburgh). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population Exposures.

Scattered radiation to the gonads from irradiation of the Mantle and Inverted-Y fields for treatment of Hodgkin's Disease were measured. The fields were duplicated on a Rando Phantom. The doses were measured with LiF. Estimates of possible hazard to progeny from these doses were done. (auth)

716 (CONF-741018-, pp 161-172) AS LOW AS PRACTICABLE: A CRITICAL APPRAISAL OF POPULATION HEALTH

RISKS FROM POWER PLANT EFFLUENTS. Hull, A. P. (Brookhaven National Lab., Upton, NY). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population Exposures.

A public controversy about the risks from radioactivity in effluents from nuclear power plants arose in the late 1960's as their utilization was growing toward large-scale commercial basis. Several scientific critics alleged variously that the existing plants had occasioned excess infant mortality in their vicinities, and that the growth of nuclear power would produce large increases in the cancer death rate in the general population. The controversy occasioned by these allegations lead the Federal Radiation Council to instigate the BEIR Committee review of the effects of exposure to low levels of ionizing radiation. It also appeared to underlie the AEC's 10 CFR 50 Appendix I proposals for numerical limits for nuclear power plant effluents. These proposals are intended to limit the exposure of any nearby individual to 5 mR/yr, and thereby would assure that the total population would be exposed to less than about 400 person-rems per year per 1,000 Mw(e) installed capacity. This critical review indicates that the critics' allegations were either without substance or irrelevant. Using BEIR estimates of the risks from radiation and recent years effluent release data, the population health risk from power reactor effluent radiation exposures appear to be generally smaller than that from fossil-fueled plant effluents. The BEIR estimates are based on the linear no-threshold hypothesis. Growing evidence suggests that this hypothesis is excessively conservative, when applied to low dose levels such as those occasioned by routine nuclear power plant effluents. Insofar as this is so, the benefits of the Appendix I proposals to reduce population exposures appear to be correspondingly exaggerated. (auth)

717 (CONF-741018-, pp 289-296) LOW LEVEL POPULATION EXPOSURE MEASUREMENTS USING THERMOLUMINESCENT DOSIMETERS. Partridge, J. E.; Broadway, J. A.; Windham, S. T.; Phillips, C. R. (Environmental Protection Agency, Montgomery, AL). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population Exposures.

A survey of the Eastern Environmental Radiation Facility's (EPA) experience with calcium fluoride:manganese thermoluminescent dosimeters (TLD) is presented. The information gained from earlier laboratory studies was applied to a thorough field evaluation of this type dosimeter. The objective of this field evaluation was to determine the usefulness of this TLD for making population exposure measurements in the range of proposed 10CFR50, Appendix I, limits. The results of a ten month investigation at an operating boiling water reactor site are given. Simultaneous TLD and pressurized ionization chamber measurements were made at several locations near the site boundary for the length of the study. The integrated exposure as recorded by the TLD's is compared with the results obtained using ionization chambers. The TLD measurements are also compared to mathematical predictions for each site. The mathematical predictions were made using the AIREM code and plant supplied stack release and meteorological data. (auth)

718 (CONF-741018-, pp 297-304) FIELD TESTING OF TSEE DOSIMETERS FOR PERSONNEL MONITORING. Gammage, R. B.; Cheka, J. S.; Saheli, N. (Oak Ridge National Lab., TN). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population Exposures.

Generally successful field tests using TSEE type dosimeters for personnel monitoring have been conducted for periods of between one day and one year and at exposures of gamma radiation ranging from essentially background level to about 100 mR/day. Performance is less satisfactory during the hottest and most humid weather of the year in Tennessee when fading is significant during three-month long exposures. Comparison with data from film, TLD and ionization chambers is satisfactory taking into account the variety of filter and absorber thicknesses used. A superior performance by the TSEE dosimeters is indicated where weaker penetrating radiations are present. The energy and angular dependence characteristics are very favorable for the purposes of x and γ dosimetry. For the task of personnel monitoring, the following have been developed: a manual reader with good reproducibility for semi-routine use, a lightproof badge, and sensitive but stable BeO ceramic dosimeters. (auth)

719 (CONF-741018-, pp 317-326) COMPARATIVE POPULATION RADIATION DOSE COMMITMENTS OF NUCLEAR AND FOSSIL FUEL ELECTRIC POWER CYCLES. Martin, J. E. (Environmental Protection Agency, Washington, DC). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population Exposures.

Past comparisons of the radiological impact of electricity generation by fossil and nuclear fuels have focused on doses to individuals from the power plants and have excluded impacts from the total cycle on the total population. A comprehensive perspective of the radiological impact of a decision to generate electricity by one means or the other is properly based on the total fuel cycle impact and the long-term total effects (environmental dose commitments) on populations. This comparison, using the BEIR Committee data, is made between a typical light-water reactor uranium fuel cycle and a typical coal fuel cycle, which discharges trace amounts of naturally-occurring radioactivity. When compared on this basis the uranium fuel cycle population impacts are found to be predominantly from long-lived radionuclides discharged in supporting parts of the cycle; the population impact from the coal cycle is primarily at the power plant. Interestingly, however, the introduction of nonradioactive carbon by coal combustion represents an offsetting factor, per unit of electricity produced, in that it reduces the environmental dose commitment of carbon-14 generated and released by the nuclear fuel cycle. On the basis of radiological impact alone, the long-term population impact of the nuclear fuel cycle appears to exceed that of the coal fuel cycle by a significant margin. (auth)

720 (CONF-741018-, pp 327-332) CONDOS: A MODEL AND COMPUTER CODE TO ESTIMATE POPULATION AND INDIVIDUAL RADIATION DOSES TO MAN FROM THE DISTRIBUTION, USE, AND DISPOSAL OF CONSUMER PRODUCTS THAT CONTAIN RADIOACTIVE MATERIALS. O'Donnell, F. R. (Oak Ridge National Lab., TN); Clark, F. H.; Burke, O. W.; McKay, L. R.; Tse, A. N.; Barker, R. F. Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population Exposures.

A model and computer code (CONDOS) is being developed that estimates radiation doses to man from distribution, use, and disposal of a variety of consumer products that contain radioactive materials. CONDOS utilizes a generalized format in which the life span of a consumer product is divided into five main stages (distribution, transport, use, disposal, and emergencies) that require descriptions of the activities by which man will be exposed to the product (events) during each stage. These descriptions delineate homogeneous groups of exposed persons, and thus facilitate the selection of individuals who represent the exposed groups. The radiation doses associated with one year of product use to the total body and selected reference organs and tissues of representative individuals can be estimated for each mode of exposure that is applicable to each event. Summation of the doses to representative individuals yields group and total population doses. An example of the use of CONDOS is presented in this paper. (auth)

721 (CONF-741018-, pp 333-346) POPULATION EXPOSURE FROM HIGH-ENERGY ACCELERATORS. Stephens, L. D.; Thomas, R. H.; Thomas, S. B. (Univ. of California, Berkeley). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population Exposures.

There is increasing interest in estimating the magnitudes of population exposure due to the operation of nuclear facilities. This paper discusses the population exposures that might result from high energy accelerators. External whole body radiation is the dominant type of radiation exposure, while exposure resulting from the leakage of radionuclides into the atmosphere or ground water is negligible. At large distances from operating accelerators, neutrons are the predominant form of radiation. The transport of high-energy neutrons through the atmosphere is not well understood at distances greater than about 1000 meters from the radiation source. Consequently, estimates of population exposure out to distances of 80 km from high energy accelerators may be quite inaccurate. It is extremely important that health physicists and administrators be aware of the limitations of estimates of population exposure. A model is described which facilitates the estimation of population exposure due to accelerators and its limitations are discussed. Suggestions are made for experimental investigations which would improve the model. (auth)

722 (CONF-741018-, pp 411-420) POPULATION EXPOSURE TO NATURAL TERRESTRIAL GAMMA RADIATION AROUND

SELECTED NUCLEAR POWER PLANT SITES. Burson, Z. G. (EG and G, Inc., Las Vegas, NV). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society, Knoxville, Tennessee, USA (21 Oct 1974).

In Population Exposures.

The average dose rates from external penetrating natural terrestrial gamma radiation have been determined from airborne survey data for specific areas surrounding each of 20 nuclear power plants. This dose rate information has been combined with population distribution data to obtain the average tissue dose-equivalent rate per person. This evaluation covers 19,400 square miles, inhabited by 4.4 million people. Average dose-equivalent rates ranged from a low of 18 mrem/yr at Oyster Creek to 113 mrem/yr at Fort St Vrain. For 18 sites in the Northeastern and North-central United States the mean terrestrial dose-equivalent rate per capita was 46 mrem/yr, while the average without regard to population distribution was 43 mrem/yr. In comparison, cosmic ray levels for the 18 sites range from 29 to 32 mrem/yr for elevations from 0 to 1200 ft above sea level. (auth)

723 (CONF-741018-, pp 421-428) ASSESSMENT OF PUBLIC RADIATION EXPOSURE IN THE VICINITY OF U. S. AEC SITES. Welty, C. G. Jr.; Tiernan, M. W. (Division of Operational Safety, Washington, DC). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population Exposures.

There are 27 major AEC sites in the United States which handle or process radioactive materials in quantities to warrant the maintenance of a routine environmental monitoring and reporting program. In 1972 as part of this routine program, these sites made an annual assessment of the radiation dose to the public which could have resulted from operations conducted at the site. Actual measurements of radioactivity in the pathways of exposure close to man are used whenever possible, although for certain nuclides, like noble gases, estimates of dose are normally made using effluent and meteorological data, and appropriate dispersion equations. Estimates include site boundary dose rates, population dose, and the whole-body 80 kilometer man-rem population dose. In 1973 estimated whole-body dose rates near the boundary of AEC sites ranged from less than 1 to about 30 mrem per year, or from less than 1 to about 6 percent of the radiation protection standard for an individual. The doses are dependent on the types of operations conducted at the particular site and often on the size of the site itself. The 80 kilometer man-rem estimates for all AEC sites ranged from less than 1 to about 195 man-rem per year, the maximum due primarily to tritium. (auth)

724 (LA-UR-74-1296) COMPUTER OPERATIONS FOR SUPPORT OF PION RADIOTHERAPY AT LOS ALAMOS. Lundy, A.; Minor, M.; Shlaer, S. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. 9p. (CONF-740830-1). Dep. NTIS $4.00.

A facility for testing the value of negative pions for radiation therapy of cancer is starting operation as part of the Clinton P. Anderson Meson Physics Facility (LAMPF) at the Los Alamos Scientific Laboratory in Los Alamos, New Mexico. LAMPF is a linear accelerator approximately one kilometer long which is designed to accelerate one milliampere (average current) of protons to an energy of 800 MeV and provide beam to several targets simultaneously on a non-interfering basis. The radiobiology and radiation therapy facility is a self-contained facility for studying the biological effects of negative pions and for evaluating their usefulness for cancer therapy by conducting clinical trials with patients. The planned computer uses in the facility include: control and monitoring of the pion beam line; experimental data acquisition; beam line modeling; treatment couch and beam energy degrader control; pion beam treatment planning; simulator data logging; patient record keeping; and communications link to the UNM Cancer Center for transmitting treatment plans, patient data, etc. (CH)

725 (ORNL-TM-4722) MEDICAL X-RAY DOSE ESTIMATION PROGRAM. Progress Report for Period Ending August 31, 1974. Poston, J. W.; Warner, G. G.; Stansbury, P. S. (Oak Ridge National Lab., Tenn. (USA)). Sep 1974. Contract W-7405-eng-26. 63p. Dep. NTIS $6.25.

A study was undertaken to determine the feasibility of providing estimates of absorbed doses to internal organs from external sources of x-ray beams in the energy range 20 to 150 keV. Monte Carlo calculations of absorbed dose per incident exposure have been completed for three monoenergetic photon beams (20, 25, and 100 keV). These calculations were for 4 × 4 cm beams incident AP or PA on the surface of a phantom. A total of 690 separate calculations have been completed, 46 for 20 keV, 322 for 25 keV, and 322 for 100 keV. The results have been transmitted in the form of computer printouts as well as on magnetic tapes. (CH)

726 (PB-232434) X-RAY EXPOSURE STUDY: 1964. Data File. Gitlin, J.; Goldstein, N.; Tucker, T. (Bureau of Radiological Health, Rockville, Md. (USA)). 1964. vp. (FDA/DF-73-011). NTIS $97.50 (mag tape).

The principal objective of the study was to provide estimates of U. S. population exposure to x-ray examinations or procedures, for a variety of demographic and x-ray facility characteristics. The data collected were intended to guide the development of programs aimed at promoting more efficient use of x-rays in medical and dental practice; to develop hypotheses and identify population groups for further research; and to establish a baseline for evaluating the effectiveness of program efforts. The design of the study included a household interview survey of a representative sample of the U. S. population and a mail followup to the x-ray facilities involved. (GRA)

727 (PB-232435) DOSE TRANSLATION STUDY, 1964. Data File. Gitlin, J.; Goldstein, N.; Gaskill, J. (Bureau of Radiological Health, Rockville, Md. (USA)). 1964. vp. (FDA/DF-73-012). NTIS $97.50 (mag tape).

Based on the exposure data collected in a 1964 x-ray exposure study, the gonad dose and the genetically significant dose for the U. S. population were estimated in the dose translation study. The application of several models was required in the process, including a model to estimate skin exposure as a function of reported technical parameters, and a dose model to estimate gonad dose from radiographic examinations, with the knowledge of the exposure to any portion of the body. An additional model was developed for estimating gonad dose from fluoroscopic examinations. (GRA)

728 (SSI-1974-017) MEASUREMENTS OF PATIENT DOSES DURING UROGRAPHIES AND ANGIOCARDIOGRAPHIES. Maripuu, E. (Statens Straalskyddsinstitut, Stockholm (Sweden)). May 1974. 20p. (In Swedish). Dep. NTIS (U. S. Sales Only) $4.00.

Measurements of radiation doses to different organs of the body during contrast media urographic and heart angiographic diagnostic radiographic studies of children were performed using LiF dosemeters. Measurements during urography were done concerning skin dose, exit dose, thyroid dose, dose to the urinary tract, and gonad dose. Measurements during angiocardiography were done concerning only thyroid dose. Some alterations of the technical procedures of urography and angiocardiography have been made which lead to smaller patient doses. (SW)

729 (SZS-164) REPORT DER STAATLICHEN ZENTRALE FUER STRAHLENSCHUTZ DER DDR. (Staatliche Zentrale fuer Strahlenschutz, Berlin (German Democratic Republic)). Jul 1974. 21p. (In German). Dep. NTIS (U. S. Sales Only) $4.25.

Separate abstracts were prepared for the two sections of this report. (CH)

For abstracts of individual sections see: 730 and 869.

730 (SZS-164, pp 1-9) IMPORTANCE OF DERMATOLOGICAL DIAGNOSTICS TO MEDICAL SUPERVISION OF OCCUPATIONALLY EXPOSED PERSONNEL. Lenz, U. Jul 1974. (In German).

The pathophysiological changes induced by ionizing radiation in the various skin layers of humans are outlined. The use of skin reactions as biological dose meters for medical personnel is discussed. (CH)

731 GROWTH PATTERNS OF TUMORS BEFORE AND AFTER IRRADIATION. Cell Kinetic Investigation With Tritiated Thymidine. Van Peperzeel, H. A. (Rijksuniversiteit, Utrecht). Biotechniek; 13: No. 4, 98-100(Apr 1974).

From spring meeting of the Netherlands Society for Laboratory Animals; Utrecht, Netherlands (7 Mar 1973).

Autonomous growth of tumours is determined by 1) the percentage of cells that divide regularly, 2) cell cycle time and 3) the percentage of cell loss. Radiotherapy is more effective in some cell cycle phases than in others. Cell-kinetic investigations on human tumours before and after irradiation or chemotherapy make it possible to work out a therapeutical scheme, so that treatment of the tumour can be applied when the cells are in the most sensitive condition. (NL)

732 COMBINED TREATMENT OF SOFT TISSUE AND OSTEOSARCOMAS BY RADIATION AND ICRF 159. Ryall, R.D.H. (Clatterbridge Hospital, Bebington, Eng.); Hanham, I.W.F.; Newton, K. A.; Hellmann, K.; Brinkley, D. M.; Hjertaas, O. K. Cancer; 34: No. 4, 1040-1045(Oct 1974).

In a pilot clinical assessment of combined radiotherapy with the antimitotic agent ICRF 159, a good response was obtained in 18

of 22 patients (82%) with soft tissue and bone sarcomas. Six patients had complete regressions and 12 had regressions of 50% or more. Two had regressions of less than 50% and only 2 showed no response. Severe toxicity requiring interruption of treatment was not observed, but skin reactions were greater than expected. No lung reactions were seen. The combination appears to be synergistic. (auth)

733 RADIATION THERAPY IN THE TREATMENT OF LOCALIZED CARCINOMA OF THE PROSTATE. Preliminary Report Using 22-MeV Photons. Perez, C. A.; Ackerman, L. V.; Silber, L; Royce, R. K. (Washington Univ., St. Louis). Cancer; 34: No. 4, 1059-1068(Oct 1974).

Preliminary results are reported with radical irradiation using 22-MeV photons in 59 patients with carcinoma of the prostate localized to the pelvis. All but 6 of the patients had extracapsular tumor extension (Stage C). This treatment technique appears to be effective in locally controlling the tumor, with low morbidity. After the 2nd year following treatment, the survival, clinically free of disease, is 50 to 60%. Approximately 15% of the patients have shown evidence of prostatic recurrence, frequently associated with distant metastasis. Of 11 patients in which postirradiation histologic sections of the prostate were reviewed, only 3 showed persistent microscopic tumor. Patients with poorly differentiated tumors had an extremely poor prognosis, a high proportion developing distant metastasis. Even though, at the present time, no definite statement can be made as to the effectiveness of radical irradiation alone in prolongation of survival of patients with carcinoma of the prostate clinically localized to the pelvis, it is imperative that this method of treatment be evaluated in controlled clinical trials with an option in which hormonal therapy will be deferred until progression of the disease or distant metastases develop. (auth)

734 HYGIENIC APPRAISAL OF RADIATION LOAD TO THE POPULATION DURING MEDICAL X-RAY EXAMINATIONS. Dermendziev, H. Letop. Khig. Epidemiol. Inst.; 5: No. 36, 27-41(1971). (In Bulgarian).

Detailed data are reported on the radiation load to the population in Bulgaria and in other countries. The increased morbidity from leukemia in all countries is pointed out. The appearance of pathologic changes in the germinal cells of individuals who have undergone x-ray procedures depends on the gonadal irradiation dose. A formula is suggested for determining genetically significant doses as well as measures for controlling the deleterious effects of x-ray diagnostic procedures. (Abstr. Bulg. Sci. Med. Lit.)

735 CALCULATION AND DISPLAY OF DOSE DISTRIBUTION IN TELETHERAPY BY THE USE OF SMALL COMPUTER (4kW). Yasukochi, H.; Tada, S.; Machida, K.; Kumura, F.; Ohshima, M. (Tokyo Univ.). Nippon Igaku Hoshasen Gakkai Zasshi; 34: No. 3, 155-161(Mar 1974). (In Japanese).

The representations of distribution maps are first numerals of the decimal point of results of the dose at the point divided by the dose at the center of tumor. By this, 0.1, 1.1, 2.1 etc. are represented by a same character 1, but it is not so difficult to differentiate in teletherapy. The calculation formula in the computer was already reported; the dose of each point was calculated by a formula of $Dt(A) = Da(F) \times f1 \times f2 \times f3 \times f4$, where Dt(A) means an absorbed dose at a certain point of "A", Da(F) air dose at the center of determined field, f1 for correction of source-point-distance according to inverse square law of SA^2/SF^2, f2 for correction of absorption by tissue between the calculating point and source represented by a formula of two logarithmic factors of $a \times 10^{-b,TAR} \times [1 + c \times (d + e \times L \times TAR)]$ (a, b, c, d, e are obtained experimentally), f3 for correction of deviation of the point from the center of radiation axis by experimental formula using arctangent of $0.5\text{-}\tan^{-1}[g(2 < ASF/L-1)]$ (g is obtained experimentally) and f4 for correction for wedge filter by an equation of first degree of A1 + A2 (SFtan < ASF/L). The calculation was possible for any source of teletherapy when the coefficients of experimental formula for f2, f3 and f4 were received, and was also possible for any number of ports under nine. Rotation and pendel methods must be simulated by multiportal irradiation under nine ports. The clinical results for daily treatment were valuable and a sample of results for maxillar cancer by two wedge ports is shown in figures. Some economical problems and further considerations are discussed. (auth)

736 SIGNIFICANCE OF RHYTHM OF LARGE FRACTION IRRADIATION FOR THERAPEUTIC EFFECT. Arungazyeva, V. V.; Sizenko, S. P. (Kiev Scientific-Research Rentgeno-Radiological and Oncological Inst.). Med. Radiol.; 19: No. 10, 74-76 (Oct 1974). (In Russian).

Results are reported on a study of the optimum interval between fractionated doses and the total duration of the radiation therapy. The normal standard dose was calculated for malignant and normal tissues. The results of radiotherapy under different regimes were tabulated. From calculation of the normal standard dose and the tabulated results it was concluded that the optimum results were obtained from a radiation course of 16 and 11 days with intervals of 72 and 48 hrs between exposures. (JSR)

737 METHODS FOR THE CALCULATION OF X-RAY SHIELD REQUIREMENTS IN A HOSPITAL DIAGNOSTIC AND THERAPEUTIC X-RAY SERVICE. Fava, G.; Latella, F.; Melella, A.; Saini, G.; Sichirollo, A. E. (Istituto Nazionale Tumori, Milan). Radiol. Med.; 60: No. 5, 413-430(May 1974). (In Italian).

Methods for the calculation of x-ray barriers for use in diagnosis and treatment services and adopted by the ICRP and standardization bureaus in the U. S., France, and W. Germany are examined. No Italian national rules exist and adoption of the ICRP method is urged. (auth)

738 MECHANISMS OF ACTION OF THE INHIBITORS OF CELL POSTRADIATION RECOVERY. V. Chromosome Aberrations in Irradiated Lymphocytes Treated With Caffeine in Man. Aikazyan, E. V.; Mikhel'son, V. M.; Zhestyanikov, V. D. (Inst. of Cytology, Leningrad). Tsitologiya; 16: No. 9, 1135-1140(Sep 1974). (In Russian).

The effect of caffeine ($6 \cdot 10^{-4}$ M) on the number of chromosome aberrations in peripheral human lymphocytes irradiated at $G_0 - G_1$ and $S - G_2$ stages consisted of increase in the number of cells with chromosome aberrations and in the frequency of single and double chromosome breaks induced by irradiation at $S - G_2$ stage, and was negligible on irradiation at $G_0 - G_1$ stage. The effect is assumed to be due to the inhibition of the DNA single-strand breaks repair. (auth)

739 THE RADIOTHERAPHY OF CNS-TUMOURS IN CHILDREN AND JUVENILES. Experience and Results of Almost Exclusive Application of High-Energy Electrons (20-35 MeV). Huenig, R.; Walther, E.; Sauer, R. (Bern Univ. (Switzerland). Zentrales Strahleninstitut). Strahlentherapie; 147: No. 6, 573-597(Jun 1974). (In German).

8 tabs.; 38 refs.

Sixty-three children and juveniles with tumors in the central nervous system were irradiated in the period between 1947 and 1970. Fifty of them were treated almost exclusively with electrons at an energy of 25 to 35 MeV, mainly by pendular technique. In 37 cases a tumor resection preceded the radiotherapy, in 5 cases a biopsy was made. A symptom-free survival period of 5 years was obtained in 27 of 61 patients (44%), without consideration of medulloblastomas in 25 of 47 patients (53%). By differentiation of the various tumor groups the "5-years symptom-free survival time" amounted to 2 in 14 in medulloblastomas, 6 in 10 in astrocytomas and astroblastomas, 5 in 7 in ependymomas and ependymoblastomas, 1 in 8 in spongioblastomas and glioblastomas, 4 in 5 in various tumors and 9 in 17 in histologically non verified tumors. None of the survivors showed signs of radiation damage. In 9 cases even by autopsy no radionecrosis was found in the irradiated region. The detailed registration and tabular demonstration of all the relevant dates of each patient permits a thorough analysis of the total number of cases. (auth)

740 BIOCHEMICAL ALTERATIONS IN BLOOD SAMPLES OF FEMALE PATIENTS WITH CARCINOMA COLLI UTERI AFTER X-RAY TREATMENT IN VITRO. Maruna, R. F. L.; Michalica, W.; Staudacher, M. (Vienna Univ. (Austria). Inst. fuer Hygiene; Vienna Univ. (Austria). 1. Frauenklinik; Vienna Univ. (Austria). 2. Chirurgische Klinik). Strahlentherapie; 147: No. 6, 624-627(Jun 1974). (In German).

2 figs.; 12 refs.

In a continuing examination on the extracorporeal irradiation of the blood of patients with carcinoma colli uteri, the effect of x rays on human blood in vitro is reported. The total activities of the acid and AT-phosphatases were higher and changes of the activities of isozymes took place. IgA-globulins examined by electrophoresis were stimulated to 3.8 rel%, and the IgG-globulins to 13.4 rel%. The other fractions of protein were not much affected except the necessary reduction of albumins by the higher level of globulins. (auth)

741 SHALL NEUTRONS BE APPLIED IN MEDICINE OR NOT? Kaercher, K. H. (Vienna Univ. (Austria). Strahlentherapeutische Klinik; Vienna Univ. (Austria). Inst. fuer Klinische Strahlenbiologie). Strahlentherapie; 147: No. 6, 557-558(Jun 1974). (In German).

3 refs.

The necessity of neutron application in tumor therapy is underlined, according to the actual technical development and the biological and clinical results obtained so far. (auth)

742 RADIOPATHOLOGY OF THE ABDOMINAL ORGANS FROM THE CLINICAL VIEWPOINT. Chone, B. (Univ., Heidelberg). Strahlenschutz Forsch. Prax.; 13: 70-77(1973). (In German).

From conference on radiosensitivity; Freiburg, Federal Republic of Germany (23 Sep 1972). See CONF-720956-.

The early symptoms of the radiopathology of the abdominal region are outlined from the clinical viewpoint. The factors modifying the radiation reaction are irradiation technique, type of radiation, height of the single dose and fractionation pattern, and individual reaction variations. The specific reactions induced in the abdominal organs are tabulated and discussed. The effects of abdominal radiopathology on radiotherapy regimes are considered. (JSR)

743 RADIOSENSITIVITY OF THE INTESTINE. Hornsey, S. (Hammersmith Hospital, London). Strahlenschutz Forsch. Prax.; 13: 78-88(1973).

From conference on radiosensitivity; Freiburg, Federal Republic of Germany (23 Sep 1972). See CONF-720956-.

Evidence has been presented to show that the primary cause of the early reaction of the intestine to radiation resulting in diarrhea, sickness, and electrolyte inbalance is the loss of epithelial cover of the intestine due to the killing of the stem cells. Fractionation of dose and low dose-rates is sparing of damage because of the large capacity for recovery from sublethal damage and the rapid regeneration of the epithelial stem cells. High RBE values for neutrons compared with x rays are obtained for intestinal damage which means that when intestine lies in the radiation field neutrons will only be of value in treating tumors with particularly high RBEs, as will be found in tumors with persistent anoxic cells. Early changes in absorption through the intestine tend to be transitory and are of little importance in radiotherapy when only small sections of the intestine are included in the radiation field. Little work has been done on the late radiation effects and the degree to which they follow the early effects. (auth)

744 RADIOPATHOLOGY OF THE KIDNEY. Bargon, G. (Univ., Ulm, Ger.). Strahlenschutz Forsch. Prax.; 13: 99-106 (1973). (In German).

From conference on radiosensitivity; Freiburg, Federal Republic of Germany (23 Sep 1972). See CONF-720956-.

The pattern of the radiopathology of the kidney is outlined on the basis of a review of current literature data. The development of sensitive techniques for the detection of early damage is discussed. Data are given for both animal research and clinical studies. (JSR)

745 RADIOSENSITIVITY OF THE GONADS. Fritz-Niggli, H. (Univ., Zurich). Strahlenschutz Forsch. Prax.; 13: 107-122 (1973). (In German).

From conference on radiosensitivity; Freiburg, Federal Republic of Germany (23 Sep 1972). See CONF-720956-.

The gonads are very radiosensitive organs and consist of cell types that are the most radiosensitive. On the basis of a literature review the effects of radiation on fecundity and fertility are discussed. The radiosensitivity pattern of germ cell is described. Possible origins of the various radiosensitivities are discussed. Endocrine functions and fertility are considered. The minimum dose for human gonads is still unknown, but the reactions of the male and female gonads to ionizing radiation are outlined. (JSR)

746 RADIOSENSITIVITY OF BONES. Heuck, F. (Katharinenhospitals, Stuttgart); Goessner, W. Strahlenschutz Forsch. Prax.; 13: 153-171(1973). (In German).

From conference on radiosensitivity; Freiburg, Federal Republic of Germany (23 Sep 1972). See CONF-720956-.

A review is made of available data on the radiosensitivity of the bones. Skeleton changes after radiation therapy, bone damage after radium incorporation, general radiopathology of the skeletal system, radiation damage after incorporation of osteotropic nuclides, and radioinduced neoplasias of the bone tissue are discussed. (JSR)

747 THERAPEUTIC ASPECTS OF MANDIBULAR OSTEORADIONECROSIS. de Coninck, A.; Kumps, J. (Catholic Univ., Louvain, Belgium). Acta Stomatol. Belg.; 70: No. 4, 387-398 (1973). (In French).

In the case of osteoradionecrosis it is important to establish the gravity of the process. If the aggression is weak, chronic, and only slightly painful, a conservative attitude should be adopted with local hygeine, antibiotherapy, and limited use of sequestrectomy. If the osteoradionecrotic state is acute, advanced, and extensive, resection is necessary and preferably by endobuccal methods. In the case of exteriorization of the mandibula, the resection is done externally. Several examples are given of specific cases and the therapy used in each. (JSR)

748 RADIATSIYA I ZASHCHITA. (Radiation and Protection). Margulis, U. Ya. Moscow; Atomizdat (1974). 160p.

The book discusses the interaction of ionizing radiation with matter, the effect of radiation on the living organism, and the protective measures required to work with radioactive substances and sources of ionizing radiation. The latest revised tolerance limits are discussed. Various kinds of radiation measuring equipment are reviewed. (SJR)

749 HYPERBARIC RADIOTHERAPY: EXPERIENCES AND PERSPECTIVES. Magno, L. (Istituto del Radio, Brescia, Italy). Radiol. Med.; 60: No. 5, 431-439(May 1974). (In Italian).

The biological premisses of hyperbaric radiotherapy are described. An account is given of the technique adopted for this form of therapy at the Istituto del Radio in the Hospital of Brescia and a series of 36 head and neck cancers so treated is presented. (auth)

750 INTEGRAL DOSE IN TWO-AXIAL TELEGAMMA-THERAPY IN CANCER OF THE UTERUS. Simbirtseva, L. P.; Luk'yanov, V. P. (Scientific-Research Inst. of Oncology, Moscow). Med. Radiol.; 19: No. 7, 72-77(Jul 1974). (In Russian).

Calculations were made of integral γ doses during therapy of cancer of the uterus using a mobile two-axial telegamma-therapy unit. Parameters considered included the field on the axis of rotation, distance between the axes, and volumes of the irradiated bodies. The results were compared with absorbed doses with static 4-field irradiation of parameters of the counter fields. According to the index of the integral absorbed dose, the mobile two-axial irradiation unit has advantages as compared to the static method of irradiation, especially in large volumes of irradiated bodies. (auth)

751 TOTAL PHOSPHATASE AND ISOZYME ACTIVITIES AND TRANSAMINASE ACTIVITIES IN THE BLOOD OF PATIENTS WITH COLLI UTERI CARCINOMA BEFORE AND AFTER PRIMARY IRRADIATION AND EXTRACORPOREAL X IRRADIATION OF THE BLOOD. Maruna, R. F. L.; Michalica, W.; Staudacher, M. (Univ., Vienna). Wien. Med. Wochenschr.; 123: No. 31-33, 489-493(1973). (In German).

The activities of transaminase and the alkaline phosphatase and its isozyme activities in the blood of patients with colli uteri carcinoma were determined before and after conventional irradiation treatment. Some of the patients also received supplementary extracorporeal x irradiation of the blood in a veno-venous shunt. The results led to the conclusion that in the radiation doses used of 5000 R no liver damage was observed. The phosphatase-isozyme, moving anodically in strong-gel thin-layer electrophoresis, in the region from A_1 to A_2—in protein electrophoresis corresponding to the beta globulin to albumin fractions—in the blood of the untreated patients are strongly reduced in comparison with the values found in healthy women. These reduced fractions were improved by conventional irradiation only 26%, whereas they reached the normal range in 91% of the patients treated with extracorporeal x irradiation of the blood. (tr-auth)

752 IMPORTANCE OF HEMATOLOGICAL INDICES IN RADIO- AND CHEMOTHERAPY IN ONCOLOGICAL PATIENTS. Solov'eva, E. A. (Inst. of Experimental and Clinical Oncology, Moscow). Vop. Onkol.; 20: No. 9, 19-23 (1974). (In Russian).

Under study were hematological indices in radiation and chemotherapy of 287 patients having various malignant tumors. (auth)

753 MORPHOLOGICAL AND METRIC ASPECTS OF URINARY BLADDER IN RADIOTHERAPY. Cataiano, E.; Malgieri, F.; Tarallo, L. (Istituto per lo Studio e la Cura dei Tumori, Naples). Radiaz. Alta Energ.; 12: No. 4, 119-127(Oct 1973). (In Italian).

In the preparation for radiotherapy, significant variations in the site, form, and dimensions of the bladder were often observed. An analytical study is presented of the parameters characteristic of the bladder morphology and location in order to evaluate average values. The deviation of individuals from these averages is documented. (tr-auth)

754 USE OF COMPUTERS IN RADIOTHERAPY. Fava, G.; Sichirollo, A. E.; Tosca, L.; Zonca, G. (Istituto Nazionale per lo Studio e la Cura dei Tumori, Milan). Radiaz. Alta Energ.; 12: No. 4, 129-137(Oct 1973). (In Italian).

The limitations of conventional dosimetry in radiotherapy are tabulated. The advantages of dosimetry with computers are outlined. Examples are given of the real-time use of computers and of the typical input and output data. The specifications for a computer to be used in a radiotherapy center are indicated. (JSR)

755 CLINICO-DOSIMETRIC STUDIES OF THE PELVIC TISSUE HETEROGENEITY IN IRRADIATION ON ROKUS AND B5M-

25 MACHINES. Afanas'ev, B. P.; Kozlov, A. P.; Luk'yanov, V. P.; Rotenberg, M. Z.; Simbirtseva, L. P. (Inst. of Oncology, Leningrad). Vop. Onkol.; 20: No. 9, 10-15 (1974). (In Russian).

The results of vaginal dosimetry in patients with cervical cancer under conditions of radiotherapy, using Rokus machine and B5M-25 betatron impact radiation of 25 MeV are described. To reveal differences in certain features of interaction with radiation of real biological media and phantom materials, a dosage in heterogenic pelvic phantom was measured, as well. The data obtained were utilized to perfect a computational method of recording medium heterogeneity in individual dosimetric planning of radiation therapy. (auth)

756 EFFECT OF IRRADIATION THERAPY ON THE MICROFLORA OF THE SKIN AND THE INTESTINE OF PATIENTS SUFFERING FROM UTERINE CERVIX CARCINOMA. Kochetkova, V. A.; Kozlova, E. S. (Scientific-Research Oncological Inst., Moscow). Zh. Mikrobiol., Epidemiol. Immunobiol.; No. 11, 106-112 (1973). (In Russian).

The microflora of skin of the inner surface of the right forearm and abdomen was studied in 52 cervix cancer patients undergoing radiation therapy. The composition of the microflora changed quantitatively after a total dose of 2000 rads and qualitatively after 4000 rads. The constant components of the intestinal microflora sharply decreased, and a number of facultative types of microbes appeared. In 34.6% of the patients there were complications (colitis, etc.) in the early part of the therapy, and intestinal dysbacteriosis developed with increasing pathogenecity of the intestinal bacilli. (tr-auth)

757 CHANGES IN THE ADENINE NUCLEOTIDES: AMP, ADP, ATP, AND NAD AND NADP CONTENTS IN HUMAN ERYTHROCYTES AFTER GAMMA RAY IRRADIATION. Wojtkowiak, Z.; Szwalek, E.; Leyko, W. (Univ., Lodz, Poland). Diagn. Lab.; 9: 33-38 (1973). (In Polish).

Fresh human erythrocytes were placed in glass test tubes and irradiated with gamma rays, the dose varying from 0.5 to 26 Krads. The compounds of the acid soluble fraction were then isolated according to the method described by Bartlett. They were separated by column chromatography using Dowex 1 × 4 200 to 400 mesh according to Mills and the changes in the adenine nucleotides AMP, ADP, ATP, and NAD and NADP contents were subsequently assayed. The greatest changes concerned AMP, where the dose of 0.5 Krad resulted in the decrease of the nucleotide content down to 60% and the approximate dose of 2 Krads in its increase up to 170% of the previous content (control being accepted as 100%). The doses from 2 to 6 Krads caused constant rising tendency in the AMP and ADP contents and a decreasing one in that of ATP. Regarding NAD and NADP only slight rise was noted when irradiated with 0.5 or 2 Krads and marked decrease when 6 up to 26 Krads had been applied. (auth)

758 COMPARISON OF LARGE AND SMALL COMPUTERS FOR RADIATION THERAPY TREATMENT PLANNING. Fenn, J. O.; Wallace, K. M.; Frey, G. D.; Travid, E. A. (Univ. of South Carolina, Charleston). Radiology; 113: No. 2, 429-433(Nov 1974).

From 59th scientific assembly and annual meeting of the radiological Society of North America; Chicago, IL (25 Nov 1973).

Since 1968, the authors have worked with a computerized dosimetry program which evolved from a telecopier link to the M. D. Anderson physics group to batch-processing systems, time-share systems, and finally to the purchase of a small dedicated system (RAD-8). Service is being provided to other centers as they develop. The costs, usage, and limitations of each system are discussed. (auth)

759 LONG-TERM NUTRITION WITH AN ELEMENTAL DIET FOLLOWING INTENSIVE ABDOMINAL IRRADIATION: REPORT OF A CASE. Haddad, H.; Bounous, G.; Tahan, W. T.; Devroede, G.; Beaudry, R.; Lafond, R. (Univ. of Sherbrooke, Quebec). Dis. Colon Rectum; 17: No. 3, 373-375(1974).

Morphologic and functional changes of the intestinal mucosa were widely observed following abdominal radiation. The case of a patient who had recurrent subacute intestinal obstruction, weight loss, and malnutrition following intensive radiation therapy for peritoneal carcinomatosis is reported. Her symptoms resolved, and her nutritional status improved and was maintained for more than eight months with the exclusive use of an elemental diet: Mead–Johnson 3200 AS made of 10 g/100 g casein hydrolysate, 14 g/100 g triglycerides (18% of which were M.C.T.), and 67 g/100 g carbohydrates. A conventional low-residue diet was not tolerated. A control diet similar to 3200 AS, but with whole casein replacing casein hydrolysate and L.C.T. replacing the 18% M.C.T., resulted in mild diarrhea, nausea, and an eight-fold increase of fecal fat. Possible roles of M.C.T., I.C.T., and protein hydrolysate are discussed. (auth)

760 PROTECTION OF CERTAIN STRUCTURES FROM HIGH DOSES OF IRRADIATION. D'Angio, G. J.; Exelby, P. R.; Ghavimi, F.; Cham, W. C.; Tefft, M. (Memorial Sloan-Kettering Cancer Center, New York). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 122: No. 1, 103-108(Sep 1974).

From 74th annual meeting of the American Roentgen Ray Society; Montreal, Quebec (25 Sep 1973).

The radiation therapist is often confronted with a therapeutic dilemma. He must decide whether to compromise with curative doses of radiation therapy, or run the alternate risk of producing severely incapacitating, if not lethal, damage to normal tissues necessarily included in the beam. Many methods are used by radiation therapists to minimize normal tissue damage. Relatively simple surgical techniques are described which were used to protect the lung, testicle, and the rectum. (auth)

761 TLVs: THRESHOLD LIMIT VALUES FOR PHYSICAL AGENTS ADOPTED BY ACGIH FOR 1973. J. Occup. Med.; 16: No. 1, 49-58(Jan 1974).

These values refer to levels of physical agents and represent conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effect. Values are discussed for heat stress, ionizing radiation, lasers, microwaves, noise, and ultraviolet radiation. (MCG)

762 AGING IN HIROSHIMA AND NAGASAKI ATOMIC BOMB SURVIVORS. Speculations Based upon the Age-Specific Mortality of Persons with Malignant Neoplasms. Anderson, R. E.; Key, C. R.; Yamamoto, T.; Thorslund, T. (Atomic Bomb Casualty Commission, Hiroshima and Nagasaki). Amer. J. Pathol.; 75: No. 1, 1-11(Apr 1974).

Evaluation of 1639 malignant tumors from 3067 autopsies of members of the Extended Life Span Study Sample reveals that death occurs earlier in those persons most heavily irradiated (≥100 rad) compared with those persons who were less exposed. This effect is particularly pronounced in the younger age categories and among females and is not attributable to a specific neoplasm. Assuming that a positive correlation exists between aging and the age-specific mortality of persons with neoplasms, it is concluded that this response is consistent with other observations which suggest the presence of accelerated or precocious aging in the most heavily irradiated group of survivors. (auth)

Vertebrates

Refer also to abstract 1016.

763 (AED-CONF-73-094-001) DIFFERENTIATION OF NEUROBLASTS AND THE POSSIBLE DISTURBING EFFECT OF IONIZING RADIATIONS AND CYTOSTATICS. Lierse, W. (Hamburg Univ. (F. R. Germany). Abt. fuer Neuroanatomie). 1973. 3p. (In German). (CONF-730483-1).

From meeting of the Anatomische Gesellschaft; Lausanne, Switzerland (8 Apr 1973).

The purpose of the experiments was to better define the properties of neuroblasts and to better mark them off against neurons and glia cells. Rats and mice were given the cytostatic drug cyclophosphamide on the day of birth. The animals were sacrificed on the 5th day. The investigation of the retina showed an impairment of the division ability and migration of the receptor neuroblasts and cell nests in the form of a rosette were found, whereas the bipolar layers and ganglion cell layers formed later were found to remain unaffected. In a second experiment the heads of the animals were subjected to a unilateral homogeneous x-ray irradiation of 500 R (100 R/min). In contrast to the neurons of the ganglia cell layer of the irradiated retinae which were unaffected, the neuroblasts of the receptors and the bipolar layers and the Mueller glia cells were destroyed by irradiation. Further experiments showed that the metabolism of the animals will be disturbed by monoiodine acetate and 6-amino-nicotinamide as the administration of monoiodine acetate results in an accumulation of glycogen in the pigmented epithelium, and 6-AN damages both the neuroblasts of the migration layer and the Mueller glia cells. (GE)

764 (BNWL-1850(PT1), pp 33-34) STUDIES WITH A PROTECTIVE AGENT. Hampton, J. C. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

The protective action of s-2(3 aminopropylamino) ethyl phosphothioic acid hydrate (WR2721) in the gastrointestinal tract of x-irradiated mice appears to be due to its effect on postmitotic cells, which remain on the villus longer than in the case of unprotected mice. (auth)

765 (BNWL-SA-5028) DOSE-EFFECT RELATIONS. Roesch, W. C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 5 Jul 1974. Contract AT(45-1)-1830. 5p. (CONF-740728-1). Dep. NTIS $4.00.

The frequency of radiation-induced effects such as tumor or leukemia induction, chromosome damage, mutation, etc., is usually expected to increase at low doses in proportion to the dose, or to the dose squared, or to a combination of the two. Experimental data seldom behave exactly this way; the values become too small as the dose increases. The deficit may be due to approach to saturation of the effect, to inhibition of the effect of interest by some other effect of the radiation, or to the influence of dose rate. The theory of these influences is discussed. (auth)

766 (GSF-B-451) MICROAUTORADIOGRAPHIC INVESTIGATIONS OF THE INCORPORATION AND RETENTION OF CALCIUM-45 IN THE KNEE-JOINT OF THE RAT FOLLOWING LOCAL X-IRRADIATION WITH 2,000 R. Kummermehr, J. (Gesellschaft fuer Strahlen- und Umweltforschung m. b. H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Biologie; Muenchen Univ. (F. R. Germany). Strahlenbiologisches Inst.). Oct 1973. 131p. (In German).

Thesis.

The effect of a local x-irradiation with 2,000 R on the mineral metabolism of the bone was investigated by means of microautoradiography of the knee-joint of rats. The 48-h incorporation of ^{45}Ca was followed up to the 22nd week following irradiation of the right knee-joint in the 8th week of life, and the retention of ^{45}Ca applied immediately after irradiation was studied up to the 9th week. Five μ thick non-decalcified bone sections were prepared of tibia, femur, and patella after acrylate embedding on an adapted Minot microtome; autoradiography of the sections has been done with stripping film. The non-irradiated side served as control. The incorporation of ^{45}Ca on the non-irradiated side showed an autoradiographic pattern characteristic of the growing long bone. The changes in the pattern observed after irradiation can be largely attributed to the disappearance of chondrocytes and osteoblasts and the absence of the corresponding cell activity. An important late effect is the development of osteosarcomas in the irradiated region, which was observed after the 15th month in eight of the twelve irradiated animals. The retention of incorporated ^{45}Ca is almost exclusively determined by the osseous growth and modification processes, due to the structure-dependence of the Ca metabolism. The amount of primary incorporated ^{45}Ca retained in the irradiated bone is much higher than in non-irradiated bones. The growth of the individual epiphyseal cartilages has been quantitatively verified in this retention experiment by micrometrical determination of the distance between the remaining labelled parts of the cartilage. Another growth process determined quantitatively by planimetric method is the structural renewal of the spongiosa of the epiphysis. On the basis of his own findings, the author discusses a number of previous investigations of local radiation damage in bones, mainly studies of the metabolism using osteotropic radionuclides, the results of which can now be interpreted in a more differentiated manner, due to the autoradiographic data. (GE)

767 CHLOROQUINE: NONSELECTIVE INHIBITION OF RECOVERY FROM RADIATION INJURY IN TUMORS AND NORMAL TISSUES. Pazmino, N. H.; Yuhas, J. M. (Univ. of Tennessee, Oak Ridge). Radiat. Res.; 60: No. 1, 54-61(Oct 1974).

The potential usefulness of the DNA repair inhibitor, chloroquine, in radiation therapy has been investigated. Contrary to the suggestions made by others, it has been demonstrated that injection of chloroquine immediately after radiation exposure inhibits recovery as effectively in the normal tissues of the mouse as it does in the tumors they bear. Further, delay of the drug injection to 2 hr after exposure has similar effects on both tumor and normal tissues, i.e., radiation recovery is not inhibited in either case. We interpret these data as indicating that the tumor and normal tissues are equally sensitive to the recovery-inhibiting effects of chloroquine and that manipulation of the timing between exposure and injection does not alter this similarity. It is unlikely, therefore, that chloroquine will be able to improve the efficacy of radiotherapy. (auth)

768 ELECTRICAL STUDIES ON NORMALLY REGENERATING, ON X-RAYED, AND ON DENERVATED LIMB STUMPS OF TRITURUS. Rose, S. M.; Rose, F. C. (Tulane Univ., New Orleans). Growth; 38: No. 3, 363-380(Sep 1974).

Nerves when present in limb stumps of Triturus viridescens polarize the regenerating end of the stump with the tip of the stump being almost constantly negative to other surface points in the regenerating region. In the absence of nerves the polarity changes frequently and the tip is positive approximately half of the time. The tips of x-rayed stumps, which do have nerves, are almost constantly negative. Their electrical pattern differs from the normal in another way. In all normally regenerating limbs the electrical polarity changes at or close to the proximal limit of the regenerating region. This change in polarity does not occur at the same level in x-rayed stumps. In all of the innervated limbs that regenerated, the tips were negative to a point on the old skin immediately behind the wound epithelium by 10 to 22 mV. That point was negative to a point at the base of the future regenerate but by fewer mV. The base of the future regenerate was positive to a slightly more proximal point. This electrical gradient pattern was never found in denervated or in x-rayed stumps. Some apparently normally innervated stumps failed to regenerate. The failure was foretold by a departure from the normal electrical pattern. Some denervated stumps regenerated after nerves had grown back into the tips. Their electrical pattern became normal before regeneration was observed. (auth)

769 HYPOXIC CELL RADIOSENSITIZERS: COMPARATIVE TESTS OF SOME ELECTRON AFFINIC COMPOUNDS USING EPIDERMAL CELL SURVIVAL IN VIVO. Denekamp, J.; Michael, B. D.; Harris, S. R. (Mount Vernon Hospital, Northwood, Eng.). Radiat. Res.; 60: No. 1, 119-132(Oct 1974).

The ability of certain electron affinic compounds to sensitize hypoxic cells to radiation was tested using an in vivo assay of epidermal cell survival. Albino mice were used, breathing either pure oxygen or pure nitrogen to obtain radiobiologically oxic or hypoxic conditions. The survival of epidermal clones was assayed macroscopically up to 3 wk after irradiation. The oxygen enhancement ratio observed in this epidermal cell system was in the range 2.5 to 2.8. Six electron affinic compounds were tested for their ability to sensitize hypoxic cells in vivo. Two of these compounds, metronidazole (Flagyl) and a 2-nitro-imidazole Ro-07-0582, were tested in detail for their sensitizing ability over wide ranges of drug doses. Both these compounds are clinical antiflagellates, with considerable pharmacological information available. Both drugs specifically sensitized hypoxic cells when administered before irradiation, but had no demonstrable effect upon well-oxygenated cells. Neither drug had any significant effect when administered after irradiation. Metronidazole gave a radiation dose enhancement ratio of 1.5 when administered at about half of the mean lethal drug dose. Ro-07-0582 was considerably more effective, giving an enhancement ratio of 1.5 at only 10% of its mean lethal drug dose; at the highest dosage used Ro-07-0582 gave an enhancement ratio of 2.2. (auth)

770 EFFECTS OF CAFFEINE ON RADIATION-INDUCED MITOTIC INHIBITION IN S-180 ASCITES TUMOR CELLS. Boynton, A. L.; Evans, T. C.; Crouse, D. A. (Univ. of Iowa, Iowa City). Radiat. Res.; 60: No. 1, 89-97(Oct 1974).

Mice containing log phase S-180 (Sarcoma 180) ascites tumor cells were given whole-body x-irradiation (50, 100, 200, 400 R) to produce mitotic inhibition (block in G_2). The effect of caffeine (1.9, 19, 194, 1942 μg) was studied by administration to the mice before x-irradiation (5, 10, 20, 40 min). The dose-related period of mitotic arrest was reduced when caffeine was administered 5 or 10 min prior to x-irradiation. This effect of caffeine was no longer evident when the period before x-irradiation was extended to 20 min. There was no such caffeine effect when administered after x-irradiation. The duration of mitotic inhibition was diminished at all concentrations of caffeine employed. (auth)

771 CHROMOSOME ABERRATIONS IN THE LEUKOCYTES OF PARTIAL-BODY- AND WHOLE-BODY-IRRADIATED SWINE. McFee, A. F.; Banner, M. W.; Sherrill, M. N. (Comparative Animal Research Lab., Oak Ridge, TN). AT-40-1-GEN-242. Radiat. Res.; 60: No. 1, 165-172(Oct 1974).

Mature Yorkshire sows were given 400-R exposures to ^{60}Co gamma radiation delivered either to the total body or to the anterior or posterior body half only. At 20 min and at 24 hr after the exposure, blood samples were taken for the determination of chromosome aberrations as well as for hematological evaluation. White blood cells were subsequently monitored through the 14th wk postexposure. The recovery from depressed leukocyte numbers in the peripheral system tended to be slower and less complete after whole-body irradiation. Both one-event and two-event chromosome aberrations were induced in the leukocytes of whole-body irradiated sows at approximately three times the level seen with half-body exposures. The results indicate that the calculation of whole-body equivalencies from chromosome aberrations scored after partial-body exposures may lead to an underestimate of the equivalent whole-body dose. (auth)

772 SYNERGISM OF ICRF 159 AND RADIOTHERAPY IN TREATMENT OF EXPERIMENTAL TUMORS. Hellmann, K.; Murkin, G. E. (Imperial Cancer Research Fund, London). Cancer; 34: No. 4, 1033-1039(Oct 1974).

ICRF 159, an antimitotic agent that increases the antitumor

activity of most antineoplastic drugs, has now also been shown to potentiate radiotherapy. This potentiation was obtained without concomitant increase in toxicity. The resulting therapeutic synergism is greater with ICRF 159 than with equiactive doses of 5-fluorouracil, methotrexate, hydroxyurea, or cyclophosphamide when they are combined with radiation. Timing of administration of ICRF 159 in relation to radiotherapy is a significant factor in determining the results obtained. (auth)

773 PHARMACOLOGICAL AND RADIOPROTECTIVE PROPERTIES OF MELITTIN. Il'yuchenok, T. Yu.; Vyatchannikov, N. K.; Sinka, A. Ya.; Frigidova, L. M.; Lepkhin, V. P.; Shadurskii, K. S. (Inst. of Medical Radiology, Obninsk, USSR). Farmakol. Toksikol.; 37: No. 3, 367-370(1974). (In Russian).

Extensive pharmacological evaluation was conducted on melittin (a 2840 MW polypeptide from bee venom), employing inbred and outbred mice, rats, guinea pigs, and rabbits. Investigated alone and in connection with other drugs melittin was demonstrated to possess anticonvulsant, analgesic, hypothermic, and antihypoxic effects. Its LD_{50} on intraperitoneal administration was 7.4 ± 0.59 mg/kg for CBA mice, 8.75 ± 1.11 mg/kg for BALB/c mice, 12.8 ± 1.0 mg/kg for outbred mice, 17.7 ± 0.7 mg/kg for Wistar rats, and 2.75 ± 0.08 mg/kg for guinea pigs; signs of intoxication were evident in rabbits on injection of 1-2 mg/kg into an ear vein. Studies on mice showed that when melittin was given subcutaneously (7 mg/kg) 30 min prior to irradiation with gamma rays (1000 R, 10 R/min) or intraperitoneally (2 mg/kg) 10 min before irradiation the corresponding survival rates were 50.0 ± 16% and 42.0 ± 11.0%, respectively, for 0.5% survival among the controls at the comparable period of time. Melittin was ineffective at higher doses of radiation (2400 R). (JPRS)

774 INHIBITION OF THE IMMUNOROSETTE FORMATION IN THE SPLEEN CELLS OF MICE BY MEANS OF COBALT IRRADIATION. Method for the Measurement of the Immunosuppressive Effects of Gamma Radiation. Fekete, B.; Szegedi, G.; Petranyi, J.; Gergely, P.; Szabo, G.; Dezsi, Z. (Univ. of Medical Sciences, Debrecen, Hungary). Kiserl. Orvostud.; 26: No. 1, 52-57(Feb 1974). (In Hungarian).

Whole-body irradiation (150 R; 46 R/min) was administered to 2-month old Balb/c male mice before (10, 6, and 3 days) and after (1, 2, and 4 days) immunization with 3×10^8 sheep red blood cells. The rosette-formation test was performed on the 4th and 8th days after immunization. The number of spleen cells clearly decreased as a result of irradiation. Irradiation preceding or coinciding with antigen stimulation resulted in more effective rosette inhibition than radiation treatment after immunization. Cobalt irradiation primarily reduced the number of T-lymphocytes; it also reduced their rosette-forming ability. It was concluded that cobalt irradiation of mice at whole-body doses of $\frac{1}{5}$ LD_{50} is an effective means for inhibiting the formation of immunorosettes. (JPRS)

775 INVESTIGATION OF RADIATION DAMAGE IN VIVO BY ^{125}I-LABELED DESOXYURIDINE. Jaszsagi-Nagy, E. (Academic Univ. Research Group for Medical Radiology, Budapest). Kiserl. Orvostud.; 26: No. 1, 40-45(Feb 1974). (In Hungarian).

The changes in the number of cells capable of synthesizing desoxyribonucleic acid after radiation exposure to various doses of irradiation by 15 MeV neutron rays (300 kV, 8 mA) and 1600 Ci gamma rays from ^{137}Cs were measured in vivo with the aid of ^{125}I-labeled desoxyuridine and a West-German whole-body counter designed for animals. The desoxyuridine was administered intravenously after irradiation of mice. The dose-effect curves indicated an initial fast-acting component, lasting for about 100 rad; thereafter, the dose-predicated changes tend to become less significant. Administration of procaine chloride prior to irradiation (perorally) decreased the severity of radiation damage. Some prophylactic effect was observed also with PI0 (5-phenyl-2-imino-4-oxo-oxazolidine) and GC (polyphosphate). Administered after irradiation, these agents were less effective in reducing radiation damage. (JPRS)

776 INFLUENCE OF COMBINED EFFECT OF MICROWAVES AND X RAYS ON PENETRABILITY OF HISTO-HEMATIC BARRIERS. Faitel'berg-Blank, V. R.; Orlova, A. V. (Odessa Agricultural Inst.). Dopov. Akad. Nauk Ukr. RSR, Ser. B; No. 8, 741-745(Sep 1974). (In Ukrainian).

The experiments were performed on 170 rats. Penetrability of histo-hematic barriers was studied as affected by x rays and microwaves. The researches showed that the x-ray irradiation with a dose of 800 R essentially changes penetrability of the histo-hematic barriers. The SAF electromagnetic field with a power of 30W at 10 and 20-minute exposition produces a normalizing effect on the content of radiophosphorus in the tissue during the whole period of observations. (auth)

777 SELF-REPRODUCING SHIFTS IN THE WOOL FIBER HISTOGENESIS AFTER X IRRADIATION OF THE SKIN. Vsevolodov, E. B.; Prusova, L. S.; Urazgaliev, A. I. (Inst. of Experimental Biology, Alma-Ata, USSR). Tsitologiya; 16: No. 9, 1141-1146(Sep 1974). (In Russian).

Wool fibers regenerating after the epilation caused by the local x irradiation of the sheep skin had lower growth rate. Spindle-form cells of the cortical layer deriving from the permanently proliferating hair bulb matrix invariably acquired less elongated form and had larger volume than those of the intact fibers. These changes were irreversible and could be observed even a year and more after irradiation. The possibility to induce persisting shifts of the cell parameters with regard to understanding of the nature of wool fibers' quantitative morphological features is discussed. (auth)

778 CHANGE IN THE NUMBER OF STEM AND ANTIBODY-FORMING CELLS IN THE SPLEEN OF UNILATERALLY NEPHRECTOMIZED MICE. Alekseeva, N. Yu.; Gambarov, S. S.; Babaeva, A. G.; Golovistikov, I. N. (Inst. of Human Morphology, Moscow). Byull. Eksp. Biol. Med.; 78: No. 9, 69-72(Sep 1974). (In Russian).

Twenty four hours after irradiation a suspension of cells of the spleen from the intact and unilaterally nephrectomized mice (obtained 19 to 21 hours after the operation) was injected to lethally irradiated F_1(CBA × C57BL/6) mice. The number of colony-forming and plaque-forming cells was determined in the spleen of irradiated recipients on the 8th day after the cell transfer. Cells of the spleen together with sheep erythrocytes were injected to irradiated recipients for determination of plaque-forming cells. From 19 to 21 days after the operation the number of colonies in the recipients' spleen either remained unchanged or was significantly reduced. At the same periods there was noted stimulation of production of antibody-forming cells coinciding in time with the period of manifestation of the capacity of lymphoid cells of the spleen of unilaterally nephrectomized mice to induce proliferation in the kidney of nonoperated on recipients. (auth)

779 NATURE OF DIVIDING CELLS IN THE REGENERATING LIVER OF XENOGENIC RADIATION CHIMERAE. Fastor, V. M.; Chernyshova, E. V.; Uryvaeva, I. V.; Khrushchov, N. G. (Inst. of Biology, Moscow). Byull. Eksp. Biol. Med.; 78: No. 9, 103-106 (Sep 1974). (In Russian).

Chromosomal analysis of cells isolated from regenerating liver of 14 xenogenic radiochimerae (mouse-rat) demonstrated that of 763 metaphases observed 95 had donor origin. Among the latter the one metaphase was tetraploid. It is most probable that cells of donor karyotype from the liver of radiation chimerae cells of donor karyotype are Kupffer's cells or elements of extramedullary foci of hemopoiesis. Polyploid cells of donor karyotype can be referred to the megakaryocytic line of differentiation or represent polyploid cells of the focus of inflammation. (auth)

780 RADIATION-INDUCED ALTERATIONS IN THE SYNTHESIS OF RIBOSOMAL AND INFORMOSOMAL PARTICLES IN RAT LIVER. Baeyens, W.; Vangheel, V. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium). Dept. de Radiobiologie); Goutier, R. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium). Dept. de Radiobiologie; Liege Univ. (Belgium). Lab. de Radiobiologie). Strahlentherapie; 147: No. 6, 660-669(Jun 1974). 5 figs.; 27 refs.

Rats were sacrified from 3 to 24 hours after 2,000 R of x-ray whole-body irradiation. In one series of experiments, ^{14}C-orotate was injected 40 to 50 min before sacrifice, and the specific radioactivity was determined in the liver polyribosome fraction and in the cytoplasmic 40 S particles. In these conditions, the polysome specific radioactivity had increased above control level 3 to 9 hrs after irradiation, and decreased below control level later. Analyses of the 40 S particles on CsCl gradients revealed that the specific radioactivity of both m-RN proteins r-RN proteins had increased 6 hrs after irradiation and fell progressively back to control level 12 to 24 hrs after irradiation. In another series, ^{14}C-orotate was injected immediately before irradiation and the specific radioactivity determined on liver polysome fraction and on r-RNA preparations analyzed on sucrose gradients. In these conditions, the specific radioactivity of both polysomes and r-RNA had progressively increased above control levels from 6 to 24 hrs after irradiation. These results indicate that irradiation at first stimulates the synthesis of m-RNA and r-RNA in normal rat liver, and that this phase of enhanced synthesis is followed by a depression of synthesis during which the r-RNA molecules labelled in greater amount the preceding stimulation phase retain a higher specific radioactivity, because they have a relatively longer life span than m-RNA and because they are less "diluted" by newly synthesized r-RNA, due to the radiation-induced depression of synthesis. (auth)

781 MICROSPECTROPHOTOMETRIC STUDY OF ACID PHOSPHATASE ACTIVITY IN IRRADIATED SQUAMOUS EPITHELIUM. Itoiz, M. E.; Frasch, A. C. C.; Volco, H. E.; Klein-Szanto, A. J. P. (Buenos Aires Univ. Nacional (Argentina). Catedra de Anatomia Patologica; Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Departamento de Radiobiologia). Strahlentherapie; 147: No. 6, 643-648(Jun 1974).

3 figs.; 2 tabs.; 12 refs.

The activity of acid phosphatase on rat epidermis was evaluated four days post x-ray irradiation of localized areas of 300 and 1,200 μ diameter (total dose of 16,000 rad). The enzyme activity was histochemically demonstrated using Gomori's reaction and measured by microspectrophotometric scannings of skin epithelium. The acid phosphatase increases in the granulous layer of the irradiated epithelium. The increase of enzyme activity per unit of epithelial area is greater when increasing the irradiated area. There is also a relationship between the increase in the granulous layer activity, the increase in epithelial thickness and the increase of keratinization. These results confirm the relationship between acid phosphatase activity and keratinization already observed in other experimental models, such as wounds and experimental ischemia. From the radiobiological point of view, these results show the importance of the extent of the irradiated area in the evaluation of the radiation damage. (auth)

782 RADIATION SENSITIVITY OF ORGANS AND ORGAN SYSTEMS IN MAMMALS AND MEN. Symposia of the Association of German Radiation Protection Doctors, Stuttgart, Germany, May 11, 1972 and Freiburg, Germany, September 23, 1972. Braun, H.; Heuck, F.; Ladner, H. A.; Messerschmidt, O.; Musshoff, K.; Streffer, C. (Eds.). Strahlenschutz in Forschung und Praxis, Band XIII. Stuttgart; Georg Thieme Verlag (1973). 107p. (In German and English). (CONF-720585-; CONF-720956-). $14.00.

Separate abstracts were prepared for each of the 17 papers presented in this symposium. (ERB)

For abstracts of individual papers see: 742–746, 783–793, and 839.

783 RADIOSENSITIVITY AND IN VITRO AND IN VIVO CELL PROLIFERATIONS. Trott, K. R. (Gesellschaft fuer Strahlen- und Umweltforschung, Nuremburg). Strahlenschutz Forsch. Prax.; 13: 1-23(1973). (In German).

From conference on radiosensitivity; Freiburg, Federal Republic of Germany (23 Sep 1972). See CONF-720956-.

Radiosensitivity and cell proliferation are reviewed from the two interconnected viewpoints of the effect of ionizing radiation on cell proliferation and the effect of cell proliferation on radiosensitivity. The references cited show that ionizing radiations inhibit cell increases in various ways. In most cases the decisive factor in the formation of organ damage may be in the long run the inhibition of unlimited multiplication of the root cells. This inhibition of unlimited multiplication induced by irradiation itself depends essentially on the proliferation activity of the cell at the time of the irradiation. (JSR)

784 RADIOSENSITIVITY OF LYMPHOCYTES. Cronkite, E. P. (Brookhaven National Lab., Upton, NY). Strahlenschutz Forsch. Prax.; 13: 13-23(1973).

From conference on radiosensitivity; Freiburg, Federal Republic of Germany (23 Sep 1972). See CONF-720956-.

Radiosensitivity of cells cannot be estimated well by the measurement of radioresistant phenomena such as DNA and enzyme synthesis, enzyme function, and antibody synthesis. Useful quantitative data can be obtained by measurement of prompt lymphocyte killing and suppression of cell proliferation involved in 1st and 2nd immune responses using Jerne plaque and transfer of GVH reaction by cells. The in vivo D_{37} for killing mitotic and interphase lymphocytes during 1st 24 hours after x ray is variable and 2 component a) D_{37} 135 and 425 rads for small thymi, b) D_{37} 57 and 520 rads for medium and small thymi, c) D_{37} 213 and 200 rads for small l. node cells. The in vitro D_{37} for killing of thymic cells are 175 R for small thymic cells, 50 R for large thymic cells. The D_{37} for suppression of incorporation of DNA precursors into DNA is of order of several kilorads. Although dose effect curves have not been performed, there seems to be no difference in response of newly-formed labeled lymphocytes and older lymphocytes to a single dose of x ray. The D_{37} of proliferating immunologically committed cells measured by transfer of GVH reaction and ability of Jerne plaque forming cells to proliferate is of order of 70 to 80 R when oxygenated. D_{37} of anoxic cells is 230 R (OER 2.7). The radioresistance of the 2nd response, measured by serum antibody titers, is greater than the radioresistance of this primary response. However, D_{37} of lymphocytes to proliferate in 1st or 2nd response is the same—about 80 R. The discrepancy is probably explained on the basis of the radioresistance of the antibody synthesizing cells already proliferated by the time of irradiation. Proliferating lymphocytes have same radiosensitivity as other cell renewal systems. Interphase lymphocytes are much more sensitive to killing than other interphase cells except oocytes. (auth)

785 PATHOPHYSIOLOGY OF THE RADIOSENSITIVITY OF BONE MARROW. Fliedner, T. H. (Univ., Ulm, Ger.). Strahlenschutz Forsch. Prax.; 13: 38-48(1973). (In German).

From conference on radiosensitivity; Freiburg, Federal Republic of Germany (23 Sep 1972). See CONF-720956-.

The structure and function of bone marrow are reviewed from the viewpoint of cell system physiology. The factors affecting the radiosensitivity of the bone marrow are (1) the bone marrow is a uniform reacting organ distributed in the skeleton as a function of the age; (2) the hemapoietic cell production systems are constituents of the bone marrow; (3) the exchange kinetics of the elements of the bone marrow matrix are low; and (4) the hematopoietic cell systems show similar structures and can be considered as a chain whose elements are characterized by radiobiological sensitivity. The radiobiology of the bone marrow is shown by detailed descriptions of its behavior under acute whole-body irradiation and under chronic whole-body irradiation. (JSR)

786 RADIOSENSITIVITY OF THE LUNG. Maisin, J. R. (CEN, Mol, Belg.). Strahlenschutz Forsch. Prax.; 13: 49-64 (1973).

From conference on radiosensitivity; Freiburg, Federal Republic of Germany (23 Sep 1972). See CONF-720956-.

The anatomy, histology, and cytology of the normal lung parenchyma are briefly reviewed. The present status of knowledge on the radiosensitivity of the lung parenchyma is summarized and the pathogenesis of radiation pneumonitis, its symptoms and treatment are described. The radiosensitivity of lung parenchyma to cancer induction is briefly discussed. (ERB)

787 RADIOREACTION OF THE LUNGS TO VARIOUS FRACTIONATION OF TELEGAMMATHERAPY ON THE BASIS OF CLINICAL AND ANIMAL-EXPERIMENT STUDIES. Hymmen, U.; Wieland, C. (Univ., Heidelberg). Strahlenschutz Forsch. Prax.; 13: 65-77(1973). (In German).

From conference on radiosensitivity; Freiburg, Federal Republic of Germany (23 Sep 1972). See CONF-720956-.

Three groups of rabbits were irradiated on the right lung with Cs γ radiation: the first group received in 4 weeks 4 doses of 1000 rad, the second group received in 4 weeks 20 doses of 200 rad for a total dose of 4000 rad, and the third group received a single dose of 4000 rad. The difference in the radioinduced effects was more pronounced between the single dose and the 4×1000 rad dose than between the 4×1000 and the 20×200 rad dose. In the latter transient changes could be detected. In studies made on patients with lung cancers the least damaging radiation rhythm was found to be at single doses of 150 to 250 rad for a total dose of 6000 to 6500 rad in 6 to 8 weeks. (JSR)

788 RADIOSENSITIVITY OF THE LIVER. Oehlert, W. (Univ., Freiburg i. B.). Strahlenschutz Forsch. Prax.; 13: 89-98 (1973). (In German).

From conference on radiosensitivity; Freiburg, Federal Republic of Germany (23 Sep 1972). See CONF-720956-.

A review of literature data on the sensitivity of the liver shows that it must be considered as a rather radiosensitive organ. The radio-induced changes in the parenchyma and mesenchyma structures of the liver and the clinically detectable changes in the liver are tabulated. Acute radiation damage is shown partially in reversible and partially in irreversible changes in the mitochondria and the endoplasmic reticulum. The changes caused by chronic radiation lead, because of increasing constriction of the blood vessel and capillary cross sections, to hypertension and to clinical and pathological-anatomical picture of liver fibrosis and cirrhosis. (JSR)

789 GENETIC RADIATION DANGERS. Traut, H. (Univ., Muenster, Ger.). Strahlenschutz Forsch. Prax.; 13: 123-128 (1973). (In German).

From conference on radiosensitivity; Freiburg, Federal Republic of Germany (23 Sep 1972). See CONF-720956-.

The principles of genetic radiation risks are outlined and the terms doubling dose and maximum permissible gonad dose are defined. Literature data on the doubling dose in the mouse are compiled and their implications are discussed. The practical aspects of these animal experimental data are briefly considered. (JSR)

790 TOLERANCE DOSES FROM THE EMBRYOLOGICAL VIEWPOINT. Kriegel, H. (GSF, Nuremburg). Strahlenschutz Forsch. Prax.; 13: 129-137(1973). (In German).

From conference on radiosensitivity; Freiburg, Federal Republic of Germany (23 Sep 1972). See CONF-720956-.

The radioinduced embryonic development disorders are tabulated from literature data on animal research and the implications for human embryonic development are considered. The relationship between radiation dose and embryonic injury is discussed. (JSR)

791 IN WHAT MANNER CAN RADIATION CAUSE BLOOD DAMAGE? Reinhold, H. S. (Univ., Rotterdam, Netherlands). Strahlenschutz Forsch. Prax.; 13: 138-148(1973). (In German).

From conference on radiosensitivity; Freiburg, Federal Republic of Germany (23 Sep 1972). See CONF-720956-.

Possible mechanisms for radioinduced damage to the blood are outlined. The contributions of survival of endothelial cells, denudation, bleeding of the organs, and permeability of the cell membranes to these mechanisms are discussed. (JSR)

792 RADIOSENSITIVITY OF CONNECTIVE TISSUE. Lamberts, H. B. (Univ., Groningen, Ger.). Strahlenschutz Forsch. Prax.; 13: 149-152(1973).

From conference on radiosensitivity; Freiburg, Federal Republic of Germany (23 Sep 1972). See CONF-720956-.

The radiosensitivity of various types of connective tissue is briefly reviewed. The interfibrillar ground-substances, composed of mucopolysaccharides, has an extremely high radiosensitivity. Fast neutrons have an RBE of 0.6 with regards to their effects on arterial walls. The implications of this finding in radiotherapy are discussed. (ERB)

793 RADIOSENSITIVITY OF THE NERVOUS SYSTEM. Franke, H. D. (Univ., Hamburg). Strahlenschutz Forsch. Prax.; 13: 172-194(1973). (In German).

From conference on radiosensitivity; Freiburg, Federal Republic of Germany (23 Sep 1972). See CONF-720956-.

A brief review is given of questions related to the radiosensitivity of the central and peripheral nervous system. The frequency of the radiogenic spinal cord necrosis was essentially determined by the height of the individual dose and the latency time is shortened by increased oxygen pressure. The regression line in the Strandquist diagram for skin necrosis has a flat pattern according to some calculations which is almost identical with the angle of inclination of spinal cord necroses. The duration of the symptom-free latency time of radionecroses of the spinal cord is 1.5 year on an average. Pathogenic factors and factors predisposing the nervous system to radiation damage are discussed. Recent results on the peripheral nerve damage, especially with respect to the plexus brachialis, are indicated. (tr-auth)

794 EFFECT OF CERTAIN ERYTHROPOIESIS STIMULATORS ON REGENERATION OF ERYTHROCYTE SYSTEM IN RATS AFTER WHOLE BODY IRRADIATION WITH SUBLETHAL DOSE OF X RAYS. Paprocka-Slonka, E.; Kuratowska, Z. (Inst. of Nuclear Research, Warsaw). Acta Haematol. Pol.; 4: 248-253(1973). (In Polish).

Wistar rats were used for study of the effects of known stimulators of erythropoiesis on radioinduced changes following one dose of 500 R of x rays to the whole body. Exogenous erythropoietin administered in single and repeated doses had no effect on the characteristics of radioinduced disturbances of erythropoiesis without respect to the time of its administration in relation to the moment of exposure. Cobalt chloride given before or after the exposure had similarly no effect on radioinduced inhibition of erythropoiesis in rats. Testosterone increased plasma erythropoietin activity if it was given before or on the 5th, 6th, and 7th days after exposure. However, stimulation of erythropoiesis (determined by incorporation of radioactive iron into red blood cells) was observed only if testosterone was injected on the 5th, 6th and 7th day after exposure. This seems to suggest that this hormone has a direct action on haemopoietic cells. (auth)

795 EFFECTS OF X-RAYS ON THE MITOTIC CYCLE AND DNA SYNTHESIS IN UTERINE EPITHELIUM. Klimkiewicz, Z.; Jonek, J.; Konecki, J. Ginekol. Pol.; 45: No. 5, 527-539(May 1974). (In Polish).

Mitotic cycles were examined in the uterine epithelium cells of animals irradiated by 600 roentgens (x rays). The changes of the mitotic cycle were observed in different lag-time after irradiation. The investigations were carried out by means of autoradiography. It was demonstrated that after irradiation of mice with x rays in a dose of 600 R, a decrease of the mitotic index occurs—which is due to inhibition of passage of the cells from the premitotic phase to true mitosis. In about 5 hours after irradiation the G_2-M block disappears. Under the effect of irradiation an inhibition of DNA synthesis takes place, which may be due to the blockade of passage of the cells from the postmitotic phase to the DNA synthesis phase. (auth)

796 ANATOMO-HISTOLOGICAL RESEARCH ON EXPERIMENTAL ESOPHAGITIS INDUCED IN RABBITS WITH HIGH-ENERGY RADIATION. Turpini, R.; Colasante, G.; Cocchi, A. (Univ. Pavia, Italy). Boll. Soc. Ital. Biol. Sper.; 49: 333-338 (15 Apr 1973). (In Italian).

As a result of clinical observations of esophagitis observed in patients treated with high-energy electrons or photons for inoperable lung tumors, a series of anatomical and histological studies were made on rabbits exposed to total fractionated doses of 1600 and 3000 rad in the region of the esophagus. The results show that photon irradiation of the thorax provokes in the esophagus a series of lesions of an infiltrative, regressive, and sometimes necrotic character. The lesions found are proportional to the photon dose. The studies on the evolution of the lesions showed that immediately after the termination of the radiation the lesions still have a very reactive character, but after 90 days they are in a regressive, necrotic, or healed stage. (JSR)

797 PARTICIPATION OF INHIBITORS IN REGULATION OF BRAIN DNases ACTIVITY IN NORM AND AFTER X IRRADIATION OF ANIMALS. Reva, O. D.; Chernenko, G. P. (Dnepropetrovsk State Univ., USSR). Ukr. Biokhim. Zh.; 46: No. 5, 606-609(1974). (In Ukrainian).

The activity of DNases in the functionally different structures of the brain—cortex and white matter of cerebral hemispheres, medulla oblongata, and cerebellum in norm and an hour after the total x irradiation with a dose of 900 to 1200 R was studied as affected by sodium p-chloromercury benzoate (PCMB). In all the brain structures under study of the control animals an inhibitor was found of the neutral DNase sensitive to PCMB and determining its irregular distribution in these areas. A similar inhibitor of acid DNase is found only in white matter of cerebral hemispheres. The total x irradiation of animals with a dose of 900 to 1200 R an hour after irradiation inhibits the activity of acid and neutral DNases. Inhibition in the activity of the enzymes under study is reversible as it is prevented by PCMB ($4 \cdot 10^{-4}$). It evidences for an indirect character of a decrease in the activity of DNases with the presence of these enzymes inhibitors sensitive to PCMB. (auth)

798 RADIOPROTECTIVE EFFECT OF SEROTONIN AND ITS INFLUENCE ON THE COURSE OF RESPIRATORY EXCHANGE IN CORRELATION TO AGE. Kautska, J.; Misustova, J.; Novak, L. (Inst. of Biophysics, Brno). Physiol. Bohemoslov.; 23: No. 5, 453-460 (1974).

The course of respiratory exchange and vasoconstrictor effects were studied in mice injected with serotonin (50 mg/kg), together with its radioprotective effect on animals irradiated with a minimum lethal exposure dose. Strain H mice aged 4, 8, and 12 weeks were used. It was found that higher radiosensitivity of 4-week-old mice was accompanied by lower serotonin protection at this age and that it correlated with higher oxygen consumption during irradiation in these young animals. An age correlation of the protective effects of serotonin was likewise manifested in the duration of protection and the mean life span of animals which died. The vasoconstrictor effects of serotonin were also confirmed, their course in correlation to age corresponding to changes both in respiratory exchange and in the protective effect of serotonin. (auth)

799 BIOCHEMICAL STUDY ON X-IRRADIATED REPRODUCTIVE TISSUES OF FEMALE GUINEA PIGS. Shah, V. C.; Bhatavdekar, J. M.; Chinoy, N. J. (Gujarat Univ., Ahmedabad, India). Indian J. Exp. Biol.; 12: No. 2, 153-155(Mar 1974).

The ovary and the uterus of the guinea pig were studied biochemically immediately after low-dose x irradiation (120 R) as well as during the recovery phases at intervals of 24, 48, and 72 hr after x irradiation. Changes in the activity of certain enzymes and metabolites revealed that x irradiation lead to disturbance in the reproductive organs. The hydrolytic enzymes were as much affected by ionizing radiations as were the oxidative enzymes. On the other hand, RNA and protein were enhanced while DNA metabolism was significantly decreased by 3 days after x irradiation. The possible enhanced steroidogenesis by the ovary as a consequence of low dose radiation has been reported. The significance of these observations with reference to reproductive disturbances are discussed. (auth)

800 CHEMICAL SENSITIZATION OF MAMMALS TO IRRADIATION. Braun, H. (Univ., Freiburg i. B.). Acta Radiol., Suppl.; No. 310, 68-74 (1971).

The thiol-binding agents IAA and NEM induce a sensitizing

action in mice when injected before a threshold lethal whole-body irradiation of 540 R. IAAM is ineffective. If the interval between the injection of IAA and the irradiation is prolonged to 1 hr, its sensitizing ability is insignificant. NEM becomes ineffective after a period of 30 min. Damage to the limiting membranes of mitochondria and an increase in the number of their inclusions in the crypt cell of the small intestine is demonstrated. (auth)

801 IONIZING RADIATION EFFECT ON PHYSIOLOGICAL STATE OF AGRICULTURAL ANIMALS. Kruglov, V. T.; Kartashov, P. A.; Sypin, V. D. pp 239-245 of Primenenie Izotopov i Yadernykh Izluchenii v Sel'skom Khozyaistve. III. Moscow; Atomizdat (1971). (In Russian)

Results are given for studies on the effect of internal irradiation from incorporation of ^{90}Sr in the bodies of cows and sheep and of external x and gamma irradiation. Sixteen breeding stock cattle (12 adults, 4 calves), 33 sheep, and 42 lambs were given ^{90}Sr daily with their food in amounts designed to cause radiation sickness of different degrees of severity. Clinical, hematological, biochemical, pathological-morphological, and immunological studies showed that the effects depended on the form, dose, and rate of the radiation dose. The gamma LD-50/50 for sheep was 330 R, and the animals died from a 1100-R whole-body x-ray dose. Thus the RBE of x rays is about 0.3 compared to gamma rays. In a 10-year period the animals given ^{90}Sr showed no evidence of tumors of bone or other organs. (tr-auth)

802 TUMOR AND NORMAL TISSUE RESPONSE TO METRONIDAZOLE AND IRRADIATION OF MICE. Stone, H. B.; Withers, H. R. (Univ. of Texas, Houston). Radiology; 113: No. 2, 441-444(Nov 1974).

The effects of metronidazole, which selectively sensitizes hypoxic cells, on the radiation response of C_3H mouse mammary carcinoma and of mouse skin and jejunal epithelium have been investigated. A dose of 2.5 mg of metronidazole/mouse reduced the TCD50 from a control value of 6360 rads to 5310, 5310, and 5400 rads, at 3, 10, and 30 minutes after i.v. injection, respectively, in mice bearing tumors 8 mm in diameter. The skin response, as measured by the DD50, was also enhanced by metronidazole, the control value being 4780 rads, compared to 3980 rads in metronidazole-treated mice. The jejunal epithelium, however, was not sensitized by metronidazole, but conversely, a slight protective effect was observed at high radiation doses. This dose of metronidazole had no effect on tumor growth rate and was not toxic to the mice. (auth)

803 CHANGES IN THE MUCOSA OF THE SMALL INTESTINE FOLLOWING METHOTREXATE ADMINISTRATION OR ABDOMINAL X-IRRADIATION. Altmann, G. G. (Univ. of Western Ontario, London). Amer. J. Anat.; 140: 263-279(Jun 1974).

Adult male rats received 5 mg methotrexate daily and were sacrificed 1, 1.5, 2, 2.5, and 3 days after the beginning of the treatment. Other groups received 9000 rads of abdominal x-radiation and were sacrificed 1, 2, and 3 days later. Histological samples were taken from five regions of the small intestine and processed for light microscopic examination. Average area occupied by the crypts and the villi respectively, was measured per unit length of histological section. A few animals received ^{3}H-thymidine an hour before the methotrexate treatment or irradiation; the histological samples were processed for radioautography. Significant mitotic activity was absent throughout the experiments. During the first 1.5 days, mainly the crypts diminished. Radioautography revealed that migration of crypt cells to the villi continued during this time. During the second and third days, the villi also showed marked diminution, and cell migration became irregular. In general, the histometric data were similar after methotrexate and irradiation. Epithelial denudation started in terminal ileum on the third day after methotrexate. The epithelium was much reduced but not yet denuding at this time in the irradiated animals. Methotrexate inhibition of DNA and RNA synthesis was assumed to be associated, respectively, with mitotic inhibition and with a decline in protein synthesis which manifested itself in villus diminution. Survival of epithelial cells varied presumably according to the amount of RNA pool and was longest in cells being in the S-phase at the onset of the treatment. The similarity of the data after irradiation implied a similar sequence of events. (auth)

804 COMPARATIVE EFFECTS OF TWO ACUTE AND TWO PROTRACTED EXPOSURES OF IONIZING RADIATION ON THE TWO-DAY CHICK EMBRYO. Harper, A. L. College Station, TX; Texas A and M Univ. (1974). 96p. University Microfilms Order No. 74-21,191.

Thesis (Ph.D.).

Chick embryos, after two days of incubation, were exposed continuously to 1000 R of ^{60}Co gamma radiation at dose rates of 0.7 R/min and 80.0 R/min and to 1500 R at 1.0 R/min and 80.0 R/min. At a dose of 1000 R, the hatchability was approximately 20% at both dose rate levels as compared to a hatchability of 60% for the controls. Both levels of the 1500 R dose killed all embryos within seven days. For the 1000 R groups the highest mortality rate occurred at approximately day eighteen of incubation. Post-irradiated embryos exposed to 1000 R at 80.0 R/min weighed significantly less at incubation days six, nine and twelve than similarly aged embryos exposed to 0.7 R/min. Embryos exposed to 1500 R at 80.0 R/min weighed less on incubation day five than embryos exposed to 1500 R at 1.0 R/min. A dose of 1000 R at 80.0 R/min produced significantly more anomalies of the beak and inferior extremities than 0.7 R/min. As determined from day old chicks, embryos exposed to 1000 R at 80.0 R/min had the cell density of the spleen reduced to slightly greater degree than did those exposed at the rate of 0.7 R/min. Histological comparisons between the two dose-rate groups failed to show any differences for the livers, duodena and ovaries. No spermatogonia were present in the testes of one-day-old chicks irradiated with 1000 R at 0.7 R/min, but chicks receiving the same dose of irradiation at 80.0 R/min did possess spermatogonia, although in fewer numbers than the controls. (Diss. Abstr. Int., B)

805 TIME-DOSE RELATIONSHIPS IN THE MOUSE ESOPHAGUS. Phillips, T. L.; Ross, G. (Univ. of California, San Francisco). Radiology; 113: No. 2, 435-440(Nov 1974).

From 59th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (25 Nov 1973).

Histologic studies indicate that early deaths after thoracic irradiation are secondary to esophageal denudation, perforation, infection, and the associated inanition. Deaths occur between one and three weeks after irradiation with a minimum point appearing in the LD_{50} at twenty-eight days. For single doses the $LD_{50/28}$ is 2682 rads; this increases to 3527 rads in 2 fractions and to 5745 rads in 10. The relationship between number of fractions and dose and number of days and dose was determined, and a formula for calculating equivalent single doses was developed: $TD = ED \cdot N^{0.28}T^{0.06}$. (auth)

806 ALTERATIONS OF LIVER DNA AFTER X-IRRADIATION. Van Lancker, J. L.; Tomura, T. (Univ. of California, Los Angeles). Cancer Res.; 34: No. 4, 699-704(Apr 1974).

When DNA is extracted from irradiated livers, a low-molecular-weight component appears in neutral and alkaline sucrose gradients after irradiation. The proportion of the smaller component in the gradient is dose dependent. The small component has a normal temperature denaturation curve and priming abilities for DNA and RNA polymerase. The changes in the properties of DNA are explainable in terms of molecular size. The high-molecular-weight component is identical to normal DNA with respect to sedimentation in neutral and alkaline sucrose gradients and priming ability for DNA polymerase. It is proposed that the appearance of a low-molecular-weight component is the consequence of double-strand breaks. Hypothetical mechanisms of production of such lesions are discussed. (auth)

807 PREDICTIVE VALUE OF THE NSD SYSTEM FOR RENAL TOLERANCE TO FRACTIONATED X-IRRADIATION IN THE PIG. Hopewell, J. W.; Berry, R. J. (Churchill Hospital, Oxford). Brit. J. Radiol.; 47: No. 562, 679-686(Oct 1974).

Changes in renal function following local x irradiation of one kidney in the pig with one, six, or 30 dose fractions were studied up to six months after treatment by ^{131}I-Hippuran renography. The doses used were based on 70% of the "skin tolerance" NSD of 1,800 rets, and doses above and below this value were given. Dose levels of 1,260 rads single dose and 1,050 rets for fractionated treatments approximated renal tolerance for single doses and fractions in 30f/39d but not for 6f/18 days. The renal tolerance for the six fraction treatment was 30 to 45% lower than in the other two treatment groups. The widely differing partial tolerance doses observed in this study infer that the NSD system cannot be applied to predict the variation in radiation dose with dose fractionation that produces equivalent damage to the kidney. (auth)

808 SIMULTANEOUS ATP-AET-SEROTONIN PROTECTION OF SPERMATOGONIA FROM MUTATIONS INDUCED BY 300R X-RAYS IN THE MOUSE. Benova, D. J.; Baev, I. A. (Inst. of Radiology and Radiation Hygiene, Sofia). Int. J. Radiat. Biol.; 26: No. 1, 47-50(Jul 1974).

Protection of spermatogonia from dominant lethal mutations induced by acute whole-body x-irradiation (300 R) was studied in C57BL mice given a simultaneous injection of AET, ATR, and serotonin. Evidence was obtained that simultaneous administration of these radioprotectors significantly reduced dominant lethality. Expected and observed rates of post-implantation loss were found to be of the same order of magnitude. (auth)

809 LATE SOMATIC EFFECTS IN SYNGENEIC RADIATION CHIMAERAS. II. Mortality and Rate of Specific Diseases. Covelli, V.; Metalli, P.; Briganti, G.; Bassani, B.; Silini, G. (CNEN, Casaccia, Italy). Int. J. Radiat. Biol.; 26: No. 1, 1-15 (Jul 1974).

Short- and long-term pathological and epidemiological observations were conducted on a group of control hybrid mice and several groups of animals irradiated with 900 rads and injected with various doses of normal isogeneic bone-marrow stem cells. Bone-marrow transplantation was effective in enhancing the short-term survival of the treated animals. By comparison with the controls, the long-term survivors showed a shortened life-span, an increased incidence of degenerative and malignant neoplastic diseases and a reduced incidence of reticulum cell sarcoma. The quantitative analysis of the data in terms of age-specific death-rate from all causes and/or with specific diseases provides a description of the basic features of a model of late radiation action, which allows the control of cellular variables and may be of potential interest in studies on radiation carcinogenesis and leukaemogenesis. (auth)

810 MORTALITY OF THE TOAD BUFO MELANOSTICTUS AFTER WHOLE-BODY X-IRRADIATION. Guha, T.; De, M. L. (Saha Inst. of Nuclear Physics, Calcutta). Int. J. Radiat. Biol.; 26: No. 1, 77-80(Jul 1974).

Radiobiological data, including survival curves, are recorded for the common Indian toad Bufo melanostictus. The whole body was exposed to mid-line in air doses of 750, 1500, and 3000R of x radiation. The experimental $LD_{50(30}$ value of 1080R was compared with that of 790R predicted by application of the published correlation between radiosensitivity and chromosome volume for amphibians. The discrepancy between these values may result from a different set of experimental conditions having been used for the measurements. (UK)

811 INVESTIGATION OF RADIATION CATARACT BY HORMONAL MANIPULATION OF LENS GROWTH. Worgul, B. V. Burlington, VT; Univ. of Vermont (1974). 277p. University Microfilms Order No. 74-22,035.

Thesis (Ph. D.).

Investigations to determine the factor(s) responsible for an observed seasonal variation in the mitotic activity of frog lens epithelium reveal that temperature and hormones are likely candidates. Thyroidal hormones are mitogenic in amphibian lens epithelium. The effect of hormones on cell cycle kinetics and macromolecular synthesis indicate that the elevation in mitotic activity is due, primarily, to an elevated growth fraction. All the cells of the epithelial population eventually enter DNA synthesis as a result of T_3 administration. The appearance of mitosis is preceded by an increase in intranuclear ^{3}H-actinomycin D binding, augmented ^{3}H-uridine and ^{3}H-amino acid incorporation, and elevated RNA and protein content. The capacity to experimentally manipulate lens growth was employed in studies on the pathogenesis of radiation cataract. X-irradiation of frog eyes with natural and experimentally-induced differences in lenticular mitotic activity reveal cataractogenesis to be dependent on the proliferative activity of the germinative zone of the lens epithelium subsequent to exposure. In every case of x-ray-induced lens opacification a disruption of the meridional rows shows a strong correlation to the severity of the associated cataract. A hypothesis to explain the aforementioned data is offered. (Diss. Abstr. Int., B)

Invertebrates

812 TOBACCO BUDWORM: EFFECTS OF ^{60}Co IRRADIATION ON FEMALE ATTRACTIVENESS AND MATING FREQUENCY. Hendricks, D. E. (Dept. of Agriculture, Brownsville, TX). J. Econ. Entomol.; 67: No. 5, 610-612(Oct 1974).

Females of Heliothis virescens (F.), when irradiated as adults with doses of ^{60}cobalt ranging from 10–50 krad and used as bait in sex lure traps in 1.8 × 1.8 × 5.5-m field cages, were at least as attractive as untreated females. Females, irradiated as pupae 4 days before eclosion, had reduced attractiveness (28% less) with a dose of 10 krad and a considerably greater reduction with a dose of 50 krad. In laboratory tests, mating frequency as determined by spermatophore counts was affected similarly; average numbers of spermatophores per mated female were reduced 18% when pupae were irradiated at 30 krad and 41% when they were irradiated at 60 krad. However, there was no significant reduction in spermatophore numbers when newly eclosed adult females were irradiated with doses ranging from 10–60 krad. (auth)

813 EFFECTS OF CARBON-14 ON THE SURVIVAL AND REPRODUCTION OF RED SCALE MALES. Robertson, G. (Univ. Adelaide). Entomol. Exp. Appl.; 17: No. 1, 31-35(1974).

The technique of producing sterile male red scale (Aonidiella aurantii (Mask.)) by treatment with ^{14}C was further investigated. In a group of males with a mean count rate of 6300 cpm, 75% emerged and mated normally with control females, but these females produced only 10% of the number of larvae produced by females mated with untreated males. In another group of males with a mean count rate of 14200 cpm, only 31% emerged but there was no further reduction in fertility. A count rate of 6000 cpm is suggested as the optimum ^{14}C content for producing viable sterile males in laboratory conditions. The prospect of using this method of sterilization in a sterile-male project is rejected because of the difficulty of producing males with a predictable level of ^{14}C, and the high variability in the numbers of larvae produced by females mated with them. (NL)

814 VIABILITY, FERTILITY, AND BEHAVIOR OF TSETSE FLIES (GLOSSINA MORSITANS) STERILIZED BY IRRADIATION UNDER VARIOUS CONDITIONS. Langley, P. A. (Bristol Univ., Eng.); Curtis, C. F.; Brady, J. Entomol. Exp. Appl.; 17: No. 1, 97-111(1974).

Glossina morsitans pupae of known age were irradiated at different times during pupal life. The ages after which irradiation did not prevent development and normal eclosion were identified. Irradiation at the earliest age that allowed normal eclosion of males resulted in decreased adult survival compared with pupae irradiated on the day of eclosion, but in both cases survival was improved by irradiating in an atmosphere of nitrogen. Pupae that had reached the day of peak male eclosion were stored at 10 to 11°C for 5 days and then produced a predictable flush of adult emergence following irradiation in nitrogen or in air. This technique, or the alternative of irradiation some days before eclosion is expected, would enable several days' collection of pupae to be treated as a single batch for the purposes of release in a sterile male control project. Laboratory measurements of several behavioural parameters showed that adult males, irradiated as pupae, can deviate from normal when compared with unirradiated controls. However, irradiation in nitrogen caused less alteration to behaviour than the lower doses in air required to achieve the same reduction in fertility. Measurements and estimates of the somatic and genetic effects of various irradiation treatments given under described conditions were used to predict the treatment that would provide the optimal population suppression in a field control project involving the release of sterilized males. Computations have shown that the optimal sterilizing treatment may differ for different target levels of population reduction, and this concept may be of considerable significance in the control of oviparous insects with greater reproductive potential than tsetse flies. (NL)

815 REPRODUCTIVE BIOLOGY AND RADIATION STERILIZATION OF THE SUGARCANE TOP BORER, TRYPORYZA NIVELLA. Ashraf, M.; Anwar, M.; Chatha, N.; Chatah, N. (Atomic Energy Agricultural Research Center, Tandoja, Pakistan). Entomol. Exp. Appl.; 17: No. 1, 61-66(1974).

Reproductive biology and gamma sterilization of the sugarcane top borer, Tryporyza nivella F., were investigated under laboratory conditions. Mating took place on the night of emergence of the moths. Females were found to mate only once. One male mated for a maximum of four times when confined with five females. The mating frequency was maximum between 23.00 and 00.30hr; the mating duration ranged from 60 to 165 min with an average of 127.5 min. On average 113 eggs were laid by a mated female and 40 by a virgin female during the total life-span. The males and females had an average life-span of 2.6 days and 2.4 days, respectively. Radiation had no adverse effect on emergence, mating, and longevity of the adults. The males were completely sterilized at 15 kR and the females at 10 kR. (NL)

816 RADIATION-INDUCED LIFE SPAN SHORTENING IN DROSOPHILA. Gartner, L. P. (Univ. of Maryland, Baltimore). Gerontologia; 19: 295-302(1973).

Wild type Drosophila melanogaster were exposed to 0, 33, 66, and 93 kR of ^{60}Co γ irradiation at 9,000/min. The life span of the flies was reduced following the radiation, and the males were more radiosensitive than the females. A theory of aging and radiation-induced life span shortening was suggested. (auth)

Radionuclide Effects (Internal Source)

Man

Refer also to abstracts 523, 525, 554, 556, 711, 716, 717, 720, 723, 731, 924, 2227, 2242, 2596, and 2604.

817 (AED-CONF-73-139-002) BONE MARROW DISEASES IN THOROTRAST PATIENTS. van Kaick, G.; Lorenz, D.; Drings, I. (Deutsches Krebsforschungszentrum, Heidelberg (F. R. Germany). Inst. fuer Nuklearmedizin). 1973. 3p. (In German). (CONF-730486-1).

From 79th meeting of the Deutsche Gesellschaft fuer Innere Medizin; Wiesbaden, F. R. Germany (29 Apr 1973).

The injected colloidal ThO_2 is stored in the RES (reticuloendothelial system) and remains in the organism for the rest of the patient's life. The share stored in the bone marrow is about 20% according to most recent findings. As the decay of thorium results in more than 95% alpha particles, the radiation dose to the storage organs and adjacent cells is considerable. In order to investigate the effect of this chronic radiation exposure on the bone marrow, 6,000 cases of Thorotrast patients and 6,000 control cases have been compiled and reviewed within the last few years. About 80% of the Thorotrast patients were already dead at the beginning of the investigation, but a number of 800 patients could be examined. Out of this group, only one patient was found to have chronic myeloid leukemia. Within the framework of a pilot study 100 Thorotrast patients and the corresponding control persons were investigated, with a moderate depression of haemoglobin content and reduced number of erythrocytes being found in the Thorotrast patients. The review of the cases of the deceased Thorotrast patients showed an increase in bone marrow diseases with a latency period of 18 years on the average. (GE)

818 (AED-CONF-73-173-002) BENEFIT/RISK ANALYSIS OF THE BETACEL BATTERY NUCLEAR-POWERED CARDIAC PACEMAKER. Smith, T. H.; Greenborg, J.; Matheson, W. E.; Schaldach, M. (McDonnell Douglas Astronautics Co., Richland, Wash. (USA). Donald W. Douglas Labs.). 1973. 9p. (MDAC-WD-2210).

This benefit/risk analysis analyzes the potential impact on the U. S. environment from unrestricted use of 20,000 pacemakers powered by these betavoltaic batteries. The beneficial effects of this device, lives saved and reduced medical expenses, result from improved reliability and operating lifetime (approximately 9 years) of Betacel battery compared with available chemical batteries. Benefits were 16,800,000/yr savings to society and 76 lives saved per year resulting in approximately 800 annual added life-years. Risks to the patient and the general population are generally less than those from natural accidents such as lightning. The benefit/risk ratios of 180 in terms of lives and 440 in monetary terms are in the range accepted by the public. (GE)

819 (AED-CONF-73-221-002) CYTOLOGIC CHANGES IN ASPIRATION BIOPSY SMEARS FROM VARIOUS CONDITIONS OF THE THYROID TREATED WITH RADIOIODINE. Droese, M.; Schneider, M. L.; Kempken, K.; Hoer, G. (Technische Univ. Muenchen (F. R. Germany). Inst. fuer Klinische Zytologie; Technische Univ. Muenchen (F. R. Germany). Nuklearmedizinische Klinik und Poliklinik). 1973. 10p. (In German). (CONF-7306100-1).

From 57th meeting of the Deutsche Gesellschaft fuer Pathologie; Karlsruhe, F. R. Germany (12 Jun 1973).

Patients with euthyroid goiter, hyperthyroidism and toxic nodules were cytologically examined by aspiration biopsy. The smears obtained in the acute and subacute phase after treatment with radioiodine showed degenerative changes as observed in aspiration biopsy smears from untreated goiters and atypical giant nuclei. Pseudocarcinomatous cytologic findings occasionally observed after treatment with thiamazole could not be found. (auth)

820 (CONF-740401-P1, pp 498-513) BASIS FOR ASSESSMENT OF RADIATION RISKS FOR A HYPOTHETICAL RELEASE OF PLUTONIUM DIOXIDE FROM A FAST REACTOR ACCIDENT. Gavankar, R. (Bechtel Power Corp., San Francisco); Durbin, P. W.; Pigford, T. H. 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

A method of assessing emergency radiation risks from a single inhalation of a $^{239}PuO_2$ aerosol is presented. The ICRP Lung Model was used to calculate organ burdens and doses resulting from a single intake. Tumor risks have been estimated from experiments in which Beagle dogs inhaled $^{239}PuO_2$ particles (Thompson et al., 1972) or were injected with ^{239}Pu citrate (Mays et al., 1970); tumor risks could be related directly to organ burdens. Tumor risk/person/rem of organ dose accumulated over 50 years, and tumor risk/person/nCi of organ burden (initial deposit in lung or 50-yr accumulated burden in bone and liver) are estimated. 17 references. (auth)

821 (CONF-741018) POPULATION EXPOSURES. Proceedings of the Eighth Midyear Topical Symposium of the Health Physics Society, Knoxville, Tennessee, October 21-24, 1974. Hart, J. C.; Ritchie, R. H.; Varnadore, B. S. (eds.). (Oak Ridge National Lab., Tenn. (USA)). Oct 1974. 446p. Dep. NTIS $10.60.

Separate abstracts were prepared for 41 papers presented at the conference. Abstracts of an additional seven papers appeared previously in NSA. For abstracts of these papers see CONF-741018 in the Report Number Index. (HLW)

For abstracts of individual papers see: 523-525, 675, 710-723, 822-837, 924, 1307, 2227, 2242, 2244, 2501, and 2604.

822 (CONF-741018-, pp 1-8) HISTORICAL DEVELOPMENT OF CONCEPTS OF RADIATION DOSE COMMITMENT. Richardson, A. C. B. (Environmental Protection Agency, Washington, DC). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population Exposures.

Calculations of future doses to individuals from ingested radioactive materials, both for estimating the consequences of radiopharmaceutical use and in connection with occupational exposure guidance, provide the first examples of the use of the concept of dose commitment. In 1958 Lindell introduced expanded concepts which later developed into UNSCEAR's definition of dose commitment in order to provide a measure of the public implication of fallout from atmospheric weapons testing. Recently, even broader concepts, variously termed the environmental dose commitment and the collective dose commitment, have been developed which encompass the total population impact of environmental levels of radioactive materials. The historical development, interrelationship, and functions of these concepts is examined with a view to defining their most useful present roles in radiation protection. (auth)

823 (CONF-741018-, pp 61-72) TEMPORARY BODY BURDENS IN DOSE-EFFECT STUDIES OF THE BRAZILIAN AREAS OF HIGH NATURAL RADIOACTIVITY. Gonzales, D. E. (Pontificia Univ. Catolica, Rio de Janeiro); Costa Ribeiro, C.; Mosse, H.; Cullen, T. L.; Pfeiffer, W. C.; Penna Franca, E.; Soares, M. J. T. Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population Exposures.

To investigate the possible dose-effect relationship of populations subjected to chronic, low level ionizing radiation, a multifaceted radiological analysis of the high background area in Guarapari is under way. Although its 12,000 population will not exhibit epidemiological manifestations, elevated rates of chromosome aberrations in the peripheral lymphocytes are observed when compared to a control population with a similar water and food supply. The chromosome break structure and the local presence in Guarapari of monazite sand containing up to 6% thorium and 0.3% uranium suggests an inhaled contamination due to alpha emitting radionuclides. A compatible study in a Rio de Janeiro gas mantle (ThO_2) factory was initiated to calibrate in an average way the highly varying radiation environment of Guarapari. Here, ^{212}Pb attached to submicron aerosols give concentrations up to 4 pCi/l of air, and workers in this type of environment are observed to have chromosome aberration rates higher than Guarapari. The resulting temporary body burdens have been assessed by extensive whole-body counting as a function of average air quality and time spent in and out of the factory. It shows daily variations with associated air concentrations, partial decay during off work hours and complete decay to individual backgrounds over a week-end period. A generalized phantom capable of modeling a wide variety of internally distributed radionuclides was developed to calibrate these temporary body burdens. Preliminary results for the average dose/work-year delivered to the cellular fraction of the blood as a critical organ are presented, and its implication on the cytogenetic and Guarapari studies is discussed. (auth)

824 (CONF-741018-, pp 121-128) THYROID TUMOR RISK FROM RADIATION DURING CHILDHOOD. Silverman, C.; Hoffman, D. A. (Bureau of Radiological Health, Rockville, MD). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population Exposures.

Estimated risks of thyroid tumor induction from head and neck region radiation during the early years of life are presented from seven followup studies that provide thyroid dose data. Five of the studies are concerned with late effects of x-ray therapy for thymic enlargement or tinea capitis, one with atomic bomb blast and one

with radioactive fallout. Mean periods of observation are 16–29 years. Risks for malignant neoplasms of the thyroid range from 0 to 6.1 cases per million children exposed per rad per year in the studies cited. Although exposure levels were generally high from environmental or therapeutic sources in the studies cited, an estimated thyroid absorbed dose of 6.5 rad was reported to be associated with thyroid cancer in one study and of 6 rad associated with thyroid adenomas in another study. Estimates are presented of thyroid absorbed doses associated with several diagnostic procedures involving the head and neck region in children. The need for evaluation of diagnostic techniques in children to minimize radiation exposure necessary for essential diagnostic information is suggested. With the passage of time and continuing study of delayed effects of ionizing radiation in man, two trends have become evident regarding tumorigenesis: more tissues were found to be susceptible to the development of radiation-induced neoplasia and lower levels of radiation were found to be associated with these effects. Because of sustained interest in radiation effects on the thyroid and extensive current use of radiation in diagnostic medicine, information about thyroid tumors associated with radiation exposure of the head and neck region during childhood is summarized and factors that must be taken into account in evaluating risks of thyroid neoplasia from such exposures are considered. (auth)

825 (CONF-741018-, pp 173-180) REVIEW OF EFFLUENTS, GENERAL POPULATION DOSES, AND OCCUPATIONAL DOSES RESULTING FROM COMMONWEALTH EDISON'S USE OF NUCLEAR POWER. Golden, J. C.; Pavlick, R. A. (Commonwealth Edison Co., Chicago). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population Exposures.

Commonwealth Edison has 5270 MWe (net) of nuclear power licensed today and an additional 9316 MWe (net) scheduled for operation by the end of 1983. Operation of these power reactors exposes people to low level environmental and occupationally incurred radiation. The integral dose "man-rem" is a useful term for measuring the total radiation dose received by a group of people because the term reflects the dose and population distributions within or around a station. At Dresden with three operating BWR units, the first of which began operation in 1960, the 1973 non-occupational population dose (to 50 miles radius) was 275 man-rem (with a shielding and occupancy factor of two included). At Quad Cities with two two-year old BWR units, the dose was 30 man-rem, and at Zion, two PWR units in startup testing, the dose was essentially zero. The 1973 occupational doses were 908 man-rem at Dresden, 201 man-rem at Quad Cities, and 15.4 man-rem at Zion. The annual population doses from natural radiations are 610,000 man-rem at Dresden, 60,000 man-rem at Quad Cities, and 720,000 man-rem at Zion. Hence, the total contribution to the population dose from operation of Commonwealth Edison's nuclear facilities—the sum of the occupational plus nonoccupational doses—is much less than one percent of that received from natural sources. The paper will present a review of the effluents, and general population and occupational doses resulting from Commonwealth Edison's use of nuclear power from 1960 to mid-1974. (auth)

826 (CONF-741018-, pp 181-190) TRENDS IN POPULATION RADIATION EXPOSURE FROM OPERATING BWR GASEOUS EFFLUENTS. Martin, J. A. Jr.; Nelson, C. B.; Peterson, H. T. Jr. (Environmental Protection Agency, Washington, DC). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population Exposures.

External radiation exposures resulting from atmospheric emissions of radionuclides from operating boiling water nuclear power reactors (BWRs) were computed using the EPA AIREM diffusion-dose code. In 1971 there were 10 operating BWRs which generated a total of 1850 megawatt-years of electrical energy. Three million curies of noble gases were discharged resulting in a population-integrated radiation dose of 900 person-rems delivered to 16 million people. In 1972 14 BWRs produced 3400 MW(e)-yrs and resulted in a total population dose of 1650 person-rem to the 22.4 million people residing within 80 km (50 miles) of these facilities. Projections for the 400 GW(e) installed BWR capacity forecast for the year 2000 indicate that over 450 potential health effects could be committed annually if only a 30-minute holdup were employed. Use of charcoal adsorption beds with a 10-day xenon holdup could reduce this annual impact to 14 potential health effects. (auth)

827 (CONF-741018-, pp 191-198) POPULATION EXPOSURE ESTIMATES AS DERIVED FROM AN ENVIRONMENTAL ASSESSMENT OF LWR FUEL CYCLE FACILITIES. Part I. Population Doses from Operating Facilities. Witherspoon, J. P. (Oak Ridge National Lab., TN). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population Exposures.

Model facilities which are typical in terms of current design, location, and surrounding populations were used as the basis for this study. The radiological impacts of a uranium mill (2000 tons of ore per day), fuel fabrication plants (5 tons of uranium dioxide fuel per day and 1 ton of uranium-plutonium oxide per day), and a fuel reprocessing plant (5 tons of fuel per day) were determined. Estimates of radiation dose to total body and organs of populations out to a distance of 50 miles were made for each facility. Sources of radioactive effluents were process dusts and airborne-tailings (mills), vented particulates (fabrication plants), and stack releases of gases and particulates (reprocessing plant). Pathways for external exposure (immersion in air and contaminated ground surface) and internal exposure (inhalation and ingestion) were considered. Estimates of radiation dose to populations (man-rems) and identification of exposure pathways and major radionuclides are given for each facility. (auth)

828 (CONF-741018-, pp 199-206) POPULATION EXPOSURE ESTIMATES AS DERIVED FROM AN ENVIRONMENTAL ASSESSMENT OF LWR FUEL CYCLE FACILITIES. Part II. Long-Term Population Doses Following Cessation of Plant Operations. Witherspoon, J. P.; Parzyck, D. C. (Oak Ridge National Lab., TN). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population Exposures.

The increased use of nuclear power reactors for generation of electricity will require a growth in the number of nuclear fuel cycle facilities to support the power reactors. Facilities in the nuclear fuel cycle release radionuclides to the environment which may contribute to population radiation dose long after the nuclear facility has ceased operation. The long-term environmental impact of model support facilities was studied. The contribution of the long-lived radionuclides released by the nuclear fuel cycle plants to long-term population exposures was calculated from the time of cessation of plant operations until significant decay of the radionuclides. The model plants were typical of current design and location, and the surrounding populations were representative of present-day populations. The model facilities included a uranium mill (2000 metric tons of ore per day), fuel fabrication plants (5 metric tons of uranium dioxide fuel per day, 1 metric ton of uranium-plutonium oxide fuel per day), and a fuel reprocessing plant (5 metric tons of fuel per day). The longest-lived radionuclides released by each type of plant were enumerated and the area of radionuclide deposition defined. The significant pathways of exposure were examined with an evaluation of the population exposure resultant from resuspension of deposited activity, ingestion of deposited radionuclides, and radiation from contaminated ground surface. Dose estimates were made for populations (man-rems) living in the vicinity of the nuclear plants, and the average dose was calculated for the critical organ for each long-lived radionuclide. (auth)

829 (CONF-741018-, pp 207-214) DETERMINATION OF GAMMA-RAY EXPOSURE IN THE VICINITY OF A BOILING WATER POWER REACTOR. Gogolak, C. V.; Miller, K. M. (Health and Safety Lab., New York). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population Exposures.

Calculations of gamma exposure due to the noble gas effluent of a boiling water power reactor were made using a Gaussian plume exposure model. Hourly meteorological data and daily average release rate data gathered on site were used as input to the model. Simultaneous measurements were made with continuously monitoring ionization chambers at seven locations between 1.3 and 8.0 km from the reactor stack for more than eight months of reactor operation to evaluate the model results. Having established the reliability of the calculations for determining exposure rates lower than 1 mR per year, estimates of the population exposure to a distance of 16 km from the plant were made. Problems involved in extending such calculations to population dose assessment are discussed. (auth)

830 (CONF-741018-, pp 223-228) EFFECT OF STACK HEIGHT ON INDIVIDUAL AND POPULATION DOSES ATTRIBUTABLE TO GASEOUS EFFLUENTS FROM A MODEL FUEL REPROCESSING FACILITY. McKay, L. R.; Witherspoon, J. P. (Oak Ridge National Lab., TN). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population Exposures.

The importance of stack height to provide sufficient atmospheric dilution for radioactive particles and gases in emissions from nuclear facilities has long been recognized. To assess the influence of stack height on radiation doses attributable to gases and particles in airborne emissions from a model fuel reprocessing facility, a plant which was typical in terms of source term, technology, location, and surrounding population was selected. A computer code was used to predict atmospheric and ground concentrations of radionuclides out to 55 miles and to estimate dose from both external (submersion in air and irradiation by a contaminated land surface) and internal (inhalation and ingestion) exposure modes. A stack height of 100 meters was selected as the base line case, and heights of 75, 50, and 20 meters were used to estimate the effect on maximum individual dose and on population dose within 55 miles, of the model facility. When a 20-meter stack height was assumed, the maximum dose to an individual was 18 times that estimated for a 100-meter stack. The corresponding population dose out to 55 miles, however, was only 1.6 times greater for the shorter stack. The maximum dose to an individual attributable to the gases tritium and krypton-85 was reduced 20-fold by increasing stack height from 20 to 100 meters. The corresponding decrease in the particulate fraction was only about 10-fold. At 55 miles, estimates of population dose varied from 668 (20-meter stack) to 414 (100-meter stack) man-rems/year. Stack height had little effect on population dose, 95% of which was attributable to the gases tritium and krypton-85. Gases deposit to such a limited extent on landscape surfaces that their ground level air concentrations measured several kilometers from a 20-meter stack are usually not much different from those for a 100-meter stack. No reduction in the particulate contribution was effected by raising stack height over 50 meters. In cases where the atmospheric release source term is comprised primarily of particulates, the decision to install taller stacks at the facilities should not be based only on reduction of population dose, but rather on maintenance of maximum individual doses within statutory limits. More effective filtration and increased stack height each may effect a particulate-dose reduction, but filtration is about twice as expensive as building a taller stack, for this typical plant, on a dollar cost per individual dose reduction basis. (auth)

831 (CONF-741018-, pp 283-288) EFFECT OF DEPOSITION VELOCITIES ON ESTIMATES OF ENVIRONMENTAL TRANSPORT AND POPULATION DOSES. Moore, R. E.; Kaye, S. V. (Oak Ridge National Lab., TN). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population Exposures.

Uncertainties in values used for deposition velocities of particulate radionuclides released to the atmosphere by nuclear facilities have led to uncertainties in estimated population doses. A computer study of 33 radionuclides, assumed to be released as particles from an LMFBR fuel reprocessing plant, was designed to evaluate the sensitivity of estimated doses to selected values for deposition velocities. Deposition velocities were varied from 0.1 to 10 cm/sec, which is approximately the range found in the literature for the few measurements that have been reported. Atmospheric dispersion from a 100-meter stack was estimated for the average annual meteorological conditions of 18 reactor sites in the United States. A uniform population distribution within a 50-mile radius of the plant was assumed. Increasing the deposition velocity increases the dose through ingestion of food produced in the area and the dose through exposure to contaminated land surfaces, but decreases the inhalation and immersion doses. The deposition velocity for each radionuclide was determined so as to give the average of the minimum and maximum doses (for whole body and for reference organs) computed over the range of deposition velocities used in this study. Nearly all of the values fall within the range 0.7 to 1.35 cm/sec, with most close to 1 cm/sec. The use of these values assures that doses would not be underestimated by more than 50%. The uncertainties for whole body dose range from ±4 to ±99%; the majority is greater than ±80%. Uncertainty limits for a total facility release can be assigned by weighting dose uncertainties for the specific radionuclides by their release rates to the environment. (auth)

832 (CONF-741018-, pp 347-354) ESTIMATION OF THE DOSE EQUIVALENT TO THE U. S. POPULATION FROM RADON IN LIQUIFIED PETROLEUM GAS. Gesell, T. F. (Univ. of Texas, Houston). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population Exposures.

Previous publications on the radiological health aspects of ^{222}Rn in liquified petroleum gas (LPG) have reported measurements of ^{222}Rn concentrations in LPG at the consumer level in 14 states and estimates of the resulting dose equivalents to the bronchial epithelium of individuals under hypothetical circumstances. In this paper the measured ^{222}Rn concentrations in LPG are incorporated with information on the production and distribution of LPG to estimate an average ^{222}Rn concentration in LPG for each state. These estimates, together with weather, demographic, and LPG consumption data are used to estimate the population dose equivalent to the bronchial epithelium of the general population from this source of ^{222}Rn. The results are compared with the estimated population dose equivalent due to ^{222}Rn in natural gas and due to ^{222}Rn present naturally in the atmosphere. (auth)

833 (CONF-741018-, pp 355-360) RADIATION DOSE FROM NATURAL GAS VS THAT FROM NUCLEAR STIMULATED NATURAL GAS. Carter, M. W.; Moghissi, A. A. (Georgia Inst. of Tech., Atlanta). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population Exposures.

Natural gas contains radon and its daughter products which contribute to the population dose. Nuclear stimulated gas may also contain tritium and krypton-85 as contaminants. It is possible to compare radiation dose from radon with that from tritium and krypton-85 using various methods. This paper describes results of such a comparison based on previous experiments with tritiated natural gas. (auth)

834 (CONF-741018-, pp 361-368) LARGE SCALE NUCLEAR GAS STIMULATION: POPULATION DOSES ESTIMATED IN THE ENVIRONMENTAL ASSESSMENT OF CARBON-14 RELEASES. Rohwer, P. S.; Barton, C. J.; Moore, R. E. (Oak Ridge National Lab., TN). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population Exposures.

Carbon-14 is present principally as $^{14}CO_2$ and $^{14}CH_4$ in natural gas from wells stimulated with nuclear explosives. The $^{14}CO_2$ probably would be removed and released to the atmosphere at a processing plant before the gas is introduced into a transmission system supplying users. The ^{14}C present as $^{14}CH_4$ and other ^{14}C hydrocarbons will be released, also as $^{14}CO_2$, at the point of gas combustion. The hypothetical situation considered is a model field of 1200 nuclearly stimulated wells developed over a 30-year period, each well releasing ultimately 2 Ci of ^{14}C as $^{14}CO_2$. We estimated doses to individual gas users, to a local population, and to the world population. Inhalation of $^{14}CO_2$ in home exposure to gas combustion products from an unvented kitchen range is estimated to result in an annual total-body dose to the resident of 0.005 millirem. The annual population dose due to $^{14}CO_2$ inhalation estimated for 1.42 million people living within 50 miles of a gas processing plant is 0.06 man-rem, with a maximum individual dose of 0.01 millirem and an average of 4×10^{-5} millirem. Assuming zero population growth, the resulting population dose commitment is 1.2×10^3 man-rems within 50 miles of the gas-processing plant and 3×10^5 man-rems for the entire world. These estimated population dose commitments are shown to be less than 10% of the population doses received annually from natural ^{14}C. The present rate of burning ^{14}C-free fossil fuels results in a theoretical annual reduction in the specific activity of $^{14}CO_2$ in the troposphere (Suess effect) that is approximately 100 times larger than the calculated increase from annual development of 40 new nuclearly stimulated wells. (auth)

835 (CONF-741018-, pp 369-374) PHILOSOPHY AND METHODOLOGY OF ASSESSMENT OF RADIATION DOSES TO POPULATIONS FROM COMBUSTION PRODUCTS OF PLOWSHARE NATURAL GAS. Barton, C. J.; Moore, R. E.; Rohwer, P. S. (Oak Ridge National Lab., TN). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population exposures.

Methods of assessing radiation doses (hereafter referred to as doses) to individuals and to populations that could result from exposure to combustion products of natural gas produced in wells stimulated by use of nuclear explosives have evolved from our work on the Gasbuggy project, the first joint industry-AEC project to use a nuclear explosive to increase natural gas production. Tritium was identified as the radionuclide of principal concern. Krypton-85 and carbon-14 are the other long-lived radionuclides present. Our dose estimations are theoretical in nature, but we strive to make them as realistic as possible by obtaining gas usage data from gas transmission and distribution companies. Studies related to the second nuclear stimulation project, Rulison, have provided improved techniques for calculating population doses from both point and area sources through use

of computer codes. The only information from the third nuclear stimulation project, Rio Blanco, that we have used is wellhead radionuclide concentrations. Attention has focused primarily on tritium (HTO) inhalation and skin absorption doses which we believe to be the critical exposure pathways. Persons exposed in homes to combustion products from unvented appliances such as kitchen ranges are believed to be the critical exposure population. Some attention has been devoted to other exposure pathways, principally those involving ingestion of consumer products by people. Illustrative results are presented for each technique described. (auth)

836 (CONF-741018-, pp 383-388) EXPOSURES DURING THE TRANSPORTATION OF RADIOACTIVE MATERIALS. Fastman, S. M. (American Insurance Association, New York). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population exposures.

Radiation exposure during the transportation of radioactive materials under normal conditions are discussed. This analysis is based on average conditions as to radiation levels outside of packages, shipping distances, exposure times, distances from shipments and the numbers of people exposed. The radiation risk that develops from transportation accidents involving nuclear materials is also described. The frequency of transportation accidents in general is evaluated. Projections are made to determine the frequency of accident involving radioactive materials. The limits on radiation levels from individual packages of radioactive materials as well as surface contamination restrictions on such packages is described. External radiation exposure levels for truck drivers, freight handlers and the general public are given for the transportation of unirradiated fuel, irradiated fuel and solid radioactive waste under normal conditions. The release of radioactivity during accident conditions is also evaluated. An evaluation is given of the consequences of transportation accidents involving shipments of nuclear fuel or solid radioactive waste. Estimates of the amount of radioactive material released in the unlikely event that a container is breached are provided, taking into account engineering assessments of a variety of package designs, actual accident experience, the properties of the fuel and radioactive waste and experience in shipment, reactor operation and storage. (auth)

837 (CONF-741018-, pp 405-410) EXAMINATION OF DESIGN PARAMETERS IN A FIELD STUDY FOR EXPOSURE EVALUATION. Broadway, J. A.; Partridge, J. E.; Windham, S. T.; Phillips, C. R. (Environmental Protection Agency, Montgomery, AL). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population exposures.

Continuous exposure measurements over several months in the vicinity of an operating BWR plant and corresponding predictions for exposure during the same time period were examined by several statistical tests. The purpose of these tests has been to quantitate parameters important in the experimental design of such investigations. Conclusions regarding the length of such studies and the number of field measurement sites required is presented. Field measurement of ground-level ^{133}Xe gaseous concentration has been compared with predicted concentrations. Implications regarding the conversion from atmospheric concentration to exposure rates are discussed. Overall implications regarding the design of other such field studies are presented. (auth)

838 SIMPLIFIED METHOD FOR CALCULATION OF DOSES ABSORBED BY PATIENTS DURING RADIOISOTOPE DIAGNOSIS. Mombelli, L.; Conte, L.; Vanoli, A. (CURMAN, Varese, Italy). Radiol. Med.; 60: No. 5, 402-412(May 1974). (In Italian).

Tables are presented for the calculation of whole-body, gonad, and other critical organ radiation doses received by patients undergoing diagnostic examinations with isotopes. Account is taken of the isotope and compound employed, the radioactivity administered, and certain individual anatomical and functional parameters. (auth)

839 LYMPH NODE ALTERATION IN HUMAN THOROTRASTOSES (PATHOLOGICAL-ANATOMIC, AUTORADIOGRAPHIC AND QUANTITATIVE STUDY BY NEUTRON ACTIVATION ANALYSIS). Wegener, K. (Univ., Heidelberg); Kampmann, H.; Wesch, H. Strahlenschutz Forsch. Prax.; 13: 24-37(1973). (In German).

From conference on radiosensitivity; Freiburg, Federal Republic of Germany (23 Sep 1972). See CONF-720956-.

In lymph nodes with high concentrations of thorotrast, the development of local or systematic malignant processes is very rare. Fibrosis predominates as the late damage. Thorotrast patients die from complications involving for the most part the reticuloendothelial system. The spleen and the muscle connective tissue in the vicinity of the thorotrastomas behave similarly to the lymph nodes. The liver in thorotrastosis occupies an exceptional place in the reticuloendothelial system: tumors and cirrhoses develop, whose complications determine the course of the illness. (JSR)

840 RECENT EXPERIENCE WITH INTRATHECAL RADIOGOLD FOR MEDULLOBLASTOMA AND EPENDYMOBLASTOMA: A PROGRESS REPORT. Fuller, L. G. A. (Memorial Sloan-Kettering Cancer Center, New York); Rogoff, E.; Deck, M.; Galicich, J.; Ghavimi, F.; Levitt, S.; Smith, C. E.; D'Angio, G. J. Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 122: No. 1, 75-79(Sep 1974).

From 74th annual meeting of the American Roentgen Ray Society; Montreal, Canada (25 Sep 1973).

Nine patients, 8 with medulloblastoma and one with ependymoblastoma, were treated with intrathecal colloidal ^{198}Au. Six of these patients were treated for cure using a combination of surgery, total neuraxis irradiation from external sources, and the intrathecal radionuclide. Five of these patients are alive and free of disease for periods ranging from 12 to 42 months (32 months median). The cauda equina syndrome, a complication encountered in some patients treated earlier with intrathecal radiogold, appears to have been avoided with the use of a new technique. This calls for the use of smaller doses of radionuclide, and prompt cephalad flow of the radioactive material by tilting the head down immediately after instillation of the isotope. (auth)

841 INPUTS FOR DOSE CALCULATIONS FROM COMPARTMENTAL MODELS. Scheibe, P. O.; Yoshikawa, B. M. (Analytical Development Associates Corp., Cupertino, CA). J. Nucl. Med.; 15: No. 11, 1025-1027(Nov 1974).

A concise method to obtain cumulated radioactivities from multicompartmental models with time delays is described. No differential equation solutions are required; the model and a solution to a set of linear algebraic equations is all that is necessary to obtain the inputs for dosimetric calculations. The method is illustrated by providing cumulated radioactivities for isotope distribution represented by a model with a flow loop and time delay. (auth)

842 POLYPHOSPHATE BONE SCANS, ^{32}P, AND ADENOCARCINOMA OF THE THYROID. Klinger, L. (Lafayette General Hospital, LA). J. Nucl. Med.; 15: No. 11, 1037-1038(Nov 1974).

A patient with thyroid adenocarcinoma which did not concentrate radioiodine was treated with ^{32}P for relief of bone pain. (auth)

843 DOSIMETRY OF COPPER RADIONUCLIDES. Chervu, L. R.; Sternlieb, I. (Albert Einstein Coll. of Medicine, Bronx, NY). J. Nucl. Med.; 15: No. 11, 1011-1013(Nov 1974).

Calculations for dosimetry of the copper radionuclides ^{64}Cu and ^{67}Cu based on physiologic considerations in patients following oral administration are presented. (auth)

844 DOSIMETRY OF RADONUCLIDES IN BLOOD. McEwan, A. C. (National Radiation Lab., Christchurch, N. Z.). Brit. J. Radiol.; 47: No. 562, 652-656(Oct 1974).

Methods were developed for determining the absorbed fraction in blood for low-energy photons, mono-energetic electrons, and β spectra emitted by radionuclides uniformly distributed within it. The absorbed dose to blood calculated on the assumption that all non-penetrating radiations are totally absorbed was shown to be overestimated by up to more than 50 per cent for β emitters and by up to >20% for nuclides having a large dose contribution from conversion electrons. (auth)

845 RADIONUCLIDE DOSIMETRY. Mitchell, T. G. (National Naval Medical Center, Bethesda, MD). Radiol. Clin. N. Amer.; 7: No. 2, 195-205(Aug 1969).

The classical method of estimating radiation dosage for internally administered radionuclides has limitations based on simplifications that are not warranted under all conditions. The absorbed fraction method overcomes these limitations and is useful for all radionuclides currently in use in clinical medicine. The dosimetry of gamma rays between 11.3 and 150 keV, which cannot be accurately determined by the classical method, is readily solved by the absorbed fraction method. Estimation of radiation dosage in the absorbed fraction method requires determination of activity-time or concentration-time integral, the equilibrium absorbed dose constant, and the absorbed fraction.

The first of these is determined from knowledge of the μCi dose in the organ at some reference time, and the time course of its stay. The equilibrium absorbed dose constant has been determined for many useful radionuclides and is listed in tabular form in Table 4. The absorbed fraction is listed in Tables 1, 2, and 3. Radiation dosage in rads is obtained as the product of concentration-time integral, equilibrium absorbed dose constant, and absorbed fraction. (auth)

Animals

Refer also to abstracts 729, 801, and 807.

846 (BNWL-1850(Pt.1)) PACIFIC NORTHWEST LABORATORY ANNUAL REPORT FOR 1973 TO THE USAEC DIVISION OF BIOMEDICAL AND ENVIRONMENTAL RESEARCH. Part 1. Biological Sciences. Thompson, R. C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Aug 1974. Contract AT(45-1)-1830. 162p. Dep. NTIS $13.60.

Separate abstracts were prepared for 51 sections of this report. One additional section reports results of studies on the regulation of enzyme activity and the organization of proteins in Neurospora crassa. A list is included of 51 publications during the period covered. (CH)

For abstracts of individual sections see: 42, 668, 764, 847–868, 874–876, 883–904, and 922.

847 (BNWL-1850(PT1), pp 2-3) INFLUENCE OF AGE ON SURVIVAL OF RATS INJECTED WITH ^{239}Pu CITRATE. Mahlum, D. D.; Sikov, M. R. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Rats were administered ^{239}Pu citrate as fetuses, newborns, weanlings or adults and observed for changes in longevity. Those injected as adults generally showed the greatest decrement in survival times and those treated prenatally showed the least change. (auth)

848 (BNWL-1850(PT1), pp 7-8) CROSS PLACENTAL STUDIES WITH ^{238}Pu. Sikov, M. R.; Dedrick, M.; Mahlum, D. D. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

The partition of ^{238}Pu among the elements of the fetoplacental unit of the rat was different from that for ^{239}Pu. The pattern of embryo mortality produced by injection at 9 days of gestation was also different for the two isotopes. (auth)

849 (BNWL-1850(PT1), pp 9-10) EFFECTS ON THE RAT EMBRYO OF COMBINED EXPOSURE TO ^{239}Pu AND TRYPAN BLUE. Sikov, M. R.; Mahlum, D. D. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Administration of 1.5 μCi of ^{239}Pu, which in itself was ineffective, to the pregnant rat at either 8.5 or 9 days of gestation increased the teratologic as well as the embryocidal effects of Trypan Blue injected at these times of gestation. (auth)

850 (BNWL-1850(PT1), pp 17-18) EFFECTS OF ^{253}Es IN WEANLING AND ADULT RATS. Mahlum, D. D.; Sikov, M. R.; Hungate, F. P. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Adult Wistar rats, injected with 2.0 μCi/kg or more of ^{253}Es, had shortened median life-spans. A lesser effect of ^{253}Es on life-span was seen in adult Fischer rats. (auth)

851 (BNWL-1850(PT1), pp 19-21) BLOOD AND BONE MARROW EFFECTS OF ^{253}Es IN MINIATURE SWINE. Ragan, H. A. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Miniature swine given 3 μCi/kg of ^{253}Es citrate intravenously at about 6 weeks old developed an absolute neutropenia and thrombocytopenia of about 3 month's duration. There was a marked depression of the myeloid to erythroid cell ratio of bone marrow during the same 3-month period. The normoblastic population was also affected, but this was not reflected in circulating red cell concentrations. (auth)

852 (BNWL-1850(PT1), pp 21-22) SERUM CONSTITUENTS IN ^{253}Es-INJECTED SWINE. Hackett, P. L. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

No significant differences were observed in blood serum constituents between mean values for control and ^{253}Es-injected swine during a period of 19 months following injection of 3 μCi/kg at age 2 months. (auth)

853 (BNWL-1850(PT1), pp 23-28) EFFECTS OF ^{90}Sr INGESTION IN MINIATURE SWINE. Ragan, H. A.; McClanahan, B. J. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Dental lesions, uterine pathology, and arthritis continue to be the major causes of death in aged swine fed ^{90}Sr for their lifetime. The F_1 generation swine at the 250 μCi/day feeding level showed some recovery in peripheral blood neutrophil and platelet values when removed from ^{90}Sr feeding at 200 days of age; lymphocyte concentrations remained below those of control swine. Leukokinetic studies failed to show differences in the half-life of tagged neutrophils of control or 125 μCi/day swine, except for one ^{90}Sr animal that had extensive myeloid metaplasia. (auth)

854 (BNWL-1850(PT1), pp 28-29) BIOCHEMICAL PARAMETERS IN ^{90}Sr-FED SWINE. Hackett, P. L. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Lowered serum globulin levels were observed in offspring of swine fed 250 μCi ^{90}Sr per day. (auth)

855 (BNWL-1850(PT1), pp 30-32) ISOENZYMES IN POSTNATAL SWINE. Hackett, P. L. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Isoenzyme values in normal infant and adult miniature swine for tissue and serum lactic dehydrogenase changed markedly during the first postnatal month, but alkaline phosphatase levels differed only in total enzyme activity. (auth)

856 (BNWL-1850(PT1), pp 36-40) DOSE-EFFECT STUDIES WITH INHALED PLUTONIUM OXIDE IN DOGS. Park, J. F.; Catt, D. L.; Craig, D. K.; Dagle, G. E.; Hackett, P. L.; Olson, R. J.; Powers, G. J.; Ragan, H. A. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Six dose-level groups (3 to 5800 nCi mean initial alveolar burden) of beagle dogs given single inhalation exposures to $^{239}PuO_2$ or $^{238}Pu^{16}O_2$ aerosols are being observed for life-span dose-effect relationships. Five dogs in the high-dose-level group exposed to $^{239}PuO_2$ died due to plutonium-induced respiratory insufficiency during the first 2 year's postexposure. The groups with mean initial alveolar burdens higher than 20 nCi show a dose-related lymphopenia which is the most sensitive indication of a biological effect in the dogs to date. (auth)

857 (BNWL-1850(PT1), pp 41-44) LATE EFFECTS OF INHALED $^{238}PuO_2$ IN DOGS. Park, J. F.; Catt, D. L.; Dagle, G. E.; Hackett, P. L.; Olson, R. J.; Powers, G. J.; Ragan, H. A. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Bone tumors were the primary cause of death in beagle dogs 4 to 6 years after inhalation of $^{238}PuO_2$. The largest fraction of the plutonium retained in the body was in the skeleton followed in descending order by liver, thoracic lymph nodes, and lung. (auth)

858 (BNWL-1850(PT1), pp 47-48) HISTOPATHOLOGIC EFFECTS OF INHALED ^{239}Pu CITRATE AND ^{239}Pu NITRATE IN DOGS. Ballou, J. E.; Dagle, G. E. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Inhaled ^{239}Pu citrate or ^{239}Pu nitrate (1.6 to 11.4 μCi deposited) produced slight to moderate pneumonitis as the major lesion in dogs sacrificed 1 to 100 days after exposure. Controls given 0.27N nitric acid developed a somewhat different lesion. None of the animals exhibited serious pathologic changes that would be expected to alter normal clearance and translocation kinetics. (auth)

859 (BNWL-1850(PT1), pp 56-59) TOXICOLOGY OF INHALED $^{238}PuO_2$, $^{239}PuO_2$, AND $^{244}CmO_x$ IN THE RAT: HIGH DOSE EFFECTS. Sanders, C. L. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Groups of rats exposed to aerosols of $^{238}PuO_2$, $^{239}PuO_2$, or $^{244}CmO_x$ were observed for distribution of radionuclides in tissues and for pulmonary pathology for periods up to a year postexposure. Plutonium-238 dioxide showed greater in vivo mobility than $^{239}PuO_2$; $^{244}CmO_x$ was highly mobile. Of the rats dying at the highest exposure levels, about 33% exhibited mostly squamous cell metaplasia and 20% mostly squamous cell neoplasia. Metaplasia developed from regions of severe alveolar scarring associated with high PuO_2 particle concentrations; neoplasms infiltrated areas of lower PuO_2 particle concentration. (auth)

860 (BNWL-1850(PT1), pp 60-61) PULMONARY CLEARANCE AND CARCINOGENICITY OF INTRATRACHEALLY INSTILLED $^{239}PuO_2$ AND ASBESTOS. Sanders, C. L. Aug 1974.

In Pacific Northwest Laboratory Annual Report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Asbestos intratracheally instilled with $^{239}PuO_2$ caused increased pulmonary retention of plutonium within asbestiotic lesions of rats. The early incidence of lung tumors was decreased by concurrent instillation of asbestos. (auth)

861 (BNWL-1850(PT1), pp 62-63) DISTRIBUTION AND CARCINOGENICITY OF INTRAPLEURALLY INJECTED $^{239}PuO_2$. Sanders, C. L. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Intrapleurally injected $^{239}PuO_2$ was rapidly cleared into peritoneal and thoracic lymphatics of rats. As compared with controls, tumor incidence was increased and median survival time decreased. Effects were less marked than following intraperitoneal injection. (auth)

862 (BNWL-1850(PT1), pp 70-71) HISTOPATHOLOGIC EFFECT OF INTRATRACHEALLY INSTILLED $^{253}EsCl_3$ IS RATS. Ballou, J. E.; Busch, R. H.; Dagle, G. E. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

The major pathologic lesions in rats produced by intratracheally instilled $^{253}EsCl_3$ were: radiation pneumonitis at a dose of 47.2 μCi/kg; osteosarcomas at a dose of 10.7 μCi/kg; and soft tissue tumors, including lung tumors, at a dose of 0.214 μCi/kg. (auth)

863 (BNWL-1850(PT1), pp 71-73) EFFECT OF INHALED $^{239}PuO_2$ ON LUNG LIPIDS. Tombropoulos, E. G.; Hadley, J. G.; Thomas, J. M.; Craig, D. K. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Rat lung mitochondria showed a significant increase in rates of lipid biosynthesis (as measured by palmitate incorporation) one day following exposure to $^{239}PuO_2$ aerosol at average lung depositions above 23 to 40 nCi. (auth)

864 (BNWL-1850(PT1), pp 74-75) TRANSMISSION OF RADIATION-INDUCED TUMORS IN BEAGLE DOGS. Frazier, M. E.; Busch, R. H. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Tumors induced in dogs by inhaled ^{238}Pu or ^{239}Pu aerosols were cultured and transmitted to 31- to 33-day-old dog fetuses in utero. Tumors developed in the pups showing similarities to the donor tumor. Studies are continuing to characterize the transmitted tumors. (auth)

865 (BNWL-1850(PT1), pp 92-96) BIOLOGICAL EFFECTS OF INHALED RADON DAUGHTERS, URANIUM ORE DUST, AND CIGARETTE SMOKING IN BEAGLE DOGS. Stuart, B. O.; Filipy, R. E.; Hackett, P. L.; Ragan, H. A.; Tombropoulous, E. G. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

After 4 years of daily inhalation exposures to 600 WL radon daughters plus uranium ore dust and/or cigarette smoking, observed pulmonary lesions in beagles include macrophage proliferation, septal fibrosis, epithelial hyperplasia, emphysema, endothelial proliferation, and bronchiolar-alveolar epithelial changes involving multiple foci of squamous metaplasia with atypia. (auth)

866 (BNWL-1850(PT1), pp 97) DISPOSITION OF LONG-LIVED URANIUM CHAIN ALPHA EMITTERS FOLLOWING REPEATED INHALATION EXPOSURES OF LABORATORY ANIMALS TO URANIUM ORE. Stuart, B. O.; Jackson, P. O. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Thorium-230 was found to separate readily in vivo from parent uranium, following inhalation of either pitchblende or carnotite uranium ore by rats, beagle dogs, and hamsters. Thorium-230 should be considered as an individual hazard in uranium mining and milling operations. (auth)

867 (BNWL-1850(PT1), pp 121) LONG-TERM EFFECTS OF INHALED DTPA IN RATS PREVIOUSLY EXPOSED TO $^{239}Pu(NO_3)_4$ AEROSOL. Ballou, J. E. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

The acute toxicity of inhaled DTPA in rats and hamsters was demonstrated but DTPA doses up to ten times the level used in humans induced only transient pathologic lesions, including a mild form of emphysema. Plutonium-239 nitrate aerosol retention in rats was reduced about 50% by six, weekly DTPA inhalations starting 20 days after Pu inhalation. The survival, weight gain, and incidence of pathologic lesions is being followed for the life-span of these animals and their appropriate treatment control groups. After 500 days there were no statistically significant differences in survival, weight change, or incidence of gross pathological lesions among rats receiving Pu with no treatment, sham treated, or treated with DTPA, despite differences in cumulative lung dose of 1200, 600, and 320 rads, respectively. The DTPA treatments did not decrease the number of early deaths nor the number of lung lesions observed grossly at sacrifice, despite the lower plutonium burden. (auth)

868 (BNWL-1850(PT1), pp 139-140) SEARCH FOR ADDITIONAL EVIDENCE OF ONCORNAVIRUS INFECTION IN THE STRONTIUM-90 RADIATION-INDUCED LEUKEMIA OF MINIATURE SWINE. Frazier, M. E.; Morris, J. E. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Two more activities considered to be diagnostic for the presence of oncornavirus have been found in cases of ^{90}Sr-induced porcine leukemia. These are reverse transcriptase activity and 70S RNA core material present in plasma. (auth)

869 (SZS-164, pp 10-18) CHANGES OF DEOXYRIBOSIDE CONCENTRATION IN URINE AND BLOOD PLASMA OF RATS AFTER INTERNAL CONTAMINATION WITH STRONTIUM 89. Solle, M.; Orban, U. Jul 1974. (In German).

The effects of single intravenous administration of ^{89}Sr (150 to 800 μCi/animal) on the concentration of total deoxyribosides in urine and blood plasma of rats were determined. After administration of more than about 300 μCi/animal deoxyriboside concentration in urine increased on the 1st and 2nd day, and then declined to subnormal values for a period of longer duration. In blood plasma, maximum values were between 12 and 24 h after administration and about 145% of normal values when 300 to 800 μCi were administered per animal. A decrease below normal values could not be observed. The results are compared with those obtained after external irradiation, and discussed with regard to the biochemical detection of radiation damages caused by internal contamination with radionuclides. (auth)

870 SINGLE TOXIC DOSES OF ^{131}I: ADMINISTRATION TO MACACA MULATTA. Preliminary Report. Conzelman, G. M. Jr.; Marks, S.; Smith, C. C. (Christ Hospital Inst. of Medical Research, Cincinnati). J. Med. Primatol.; 2: 313-320 (1973).

The thyroid damaging effects of the administration of single doses of 0.5, 1.0, or 2.0 mCi of ^{131}I to groups of juvenile monkeys weighing 1.9 to 2.9 kg were studied. 24-hour uptake of a tracer dose of ^{131}I was determined before and after the damaging doses were administered. Pathologic effects in the thyroid gland ranged from mild interstitial inflammation to focal infarction. (auth)

871 SURVIVAL OF SKIN HOMOGRAFTS IN DOGS INJECTED WITH ^{109}Pd-PROTOPORPHYRIN. Fawwaz, R. A.; Frye, F.; Laughman, W. D.; Hemphill, W. (Donner Lab., Berkeley, CA). Contract W-7405-eng-48. J. Nucl. Med.; 15: No. 11, 997-1002 (Nov 1974).

Intravenous administration of ^{109}Pd-protoporphyrin was demonstrated to localize in peripheral lymphoid tissue, thus accomplishing selective radiation destruction of lymphatic tissues responsible for homograft rejection. In two dogs, so treated, skin homografts continued healthy for 5 months after transplantation as shown by lack of acute rejection, physical characteristics, and chromosome markers. (auth)

872 EFFECT OF MATERNALLY ADMINISTERED PHOSPHOROUS-32 ON PRE- AND POSTNATAL MORTALITY AND DEVELOPMENT IN MICE. Krishna, M.; Ebenezer, D. N.; Ramchander, P.; Reddi, O. S. (Osmania Univ., Hyderabad, India). Indian Soc. Nucl. Tech. Agr. Biol., Newslett.; 2: No. 1, 27-29 (1973).

Pregnant mice were injected intraperitoneally with 10 μ Ci of radiophosphorous on 3.5 day of gestation and allowed to litter. The ratio of successful copulations was drastically reduced in the treated groups indicating a preponderance of whole litter losses before implantation. The reduced litter size at birth and weaning showed a marked effect on post implantation deaths, following irradiation with ^{32}P at the early stages of pregnancy. There was no effect on foetal weight at birth and on the body weight among the offspring of the treated females during the first 8 weeks of life except at 1st, 2nd, 3rd, and 6th week where the body weight in experimental group decreased significantly as compared to controls. The results agree with the data obtained with external radiations during the preimplantation period. (Indian Sci. Abstr.)

Microorganisms

Refer also to abstract 813.

873 EFFECT OF RADIOIODINE (^{131}I) ON ESCHERICHIA COLI B WILD TYPE. Bhavnani, D.; Polasa, H. (Osmania Univ., Hyderabad, India). Indian J. Exp. Biol.; 12: No. 2, 202(Mar 1974).

Growth rates of E. coli B wild type were similar in complete medium with and without ^{131}I. However, reduction in growth was found in minimal medium containing ^{131}I. The radioisotope produced about 3% more auxotrophs in complete medium and about 12% more in minimal medium than in the respective controls. (auth)

Nuclide Kinetics and Toxicology

Man

Refer also to abstracts 42, 554, and 556.

874 (BNWL-1850(PT1), pp 82-84) RADIOLOGICAL CHARACTERIZATION OF URANIUM MINE AEROSOLS. Jackson, P. O. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Measurement of aerosols generated in operating uranium mines in simulated uranium mine atmospheres indicates four aerosol component distributions. Relative attachment sizes of radon daughters depend upon the nature and time sequence of mining operations. (auth)

875 (BNWL-1850(PT1), pp 87-89) CHARACTERIZATION OF THE ORGANIC COMPONENTS IN ANIMAL TEST CHAMBER AND URANIUM MINE AEROSOLS. Petersen, M. R. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Diesel exhaust soot may contribute to the health problems to miners posed by radon daughters in uranium mine air. The levels and size distributions of benzo(a)pyrene, and the non-volatile n-alkanes absorbed on mine air particulates were determined. (auth)

876 (BNWL-1850(PT1), pp 102-103) EFFECTIVE HALF-LIFE OF ^{137}Cs IN BONE. Palmer, H. E. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Since the amount of stable Cs in bone is 10 to 20 times the total amount present in other body tissues, it is possible that there may be a heretofore undetected long-lived component ^{137}Cs in bone. If a long-lived Cs component exists, it would be important in the evaluation of environmental exposure. In addition to ^{137}Cs from fallout, small amounts of ^{137}Cs are expected to be released to the biosphere from nuclear power reactors. Measurements were made at about 2-month intervals on an Eskimo student attending school at Chemawa, Oregon to test the hypothesis concerning a long-lived component of ^{137}Cs. The measurements indicated that if the phenomenon exists, it is such a small factor compared to total body cesium as to be of no significance in dosimetry considerations. (auth)

877 (CEA-CONF-2555) RADON PROTECTION IN URANIUM MINES. Pradel, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). 1973. 12p. (CONF-730915-15). Dep. NTIS (US Sales Only) $4.00.

From Symposium on noble gases; Las Vegas, Nevada, USA (24 Sep 1973).

Radon-222 is present naturally in uranium mines. Radon protection in the uranium mines is important because excess of lung cancer can be observed among miners working under poor conditions. It is difficult but urgent to set up a precise standard. Physical data of use in order to define this standard are presented. The standard should not use as a unit the total potential α energy unless biological data justify it, for these measurements are more difficult to carry out than those of radon concentration, the latter being moreover better representative of the concentration of the uncombined ultrafine particles. If one hopes to lower the pollution levels, new means of protection have to be looked for, and overpressurising the mines can already be considered to be effective. As to monitoring, because the first tests were satisfactory, the use of personal detectors can be forseen at least for part of the miners. (auth)

878 CHANGES OF ^{241}Am CONTENT IN FOUR PERSONS. Dolgirev, E. I.; Kaidanovskii, G. N.; Likhtareva, T. M.; Porozov, N. V. (Leningrad Scientific-Research Inst. of Radiation Hygiene). Med. Radiol.; 19: No. 10, 72-74(Oct 1974). (In Russian).

The use of scintillation detectors with thin crystals of NaI and special calibration of the apparatus makes it possible to measure ^{241}Am in the human organism at the level of tenth parts of the permissible concentration and to follow the dynamics of the accumulation and elimination of the radionuclide in the organs and tissues of people in the early period after accumulation. The use of the matrix method of calculation makes it possible to calculate separately the ^{241}Am content of organs and tissues. It was established that AmO_2, entering the human organism by inhalation, is deposited in the lungs. Subsequently a slow redistribution of the radionuclide occurs in the organs and tissues with preferential deposition in the liver and skeleton. (tr-auth)

879 MECHANISM AND KINETICS OF CHROMIUM-51 UPTAKE BY PLATELETS AND ITS RELATION TO CELL AGE. Steiner, M.; Tsukada, T. (Memorial Hospital, Pawtucket, RI). Acta Univ. Carolinae, Med., Monogr.; 53: 287-290(1972).

Radioactive chromate by far the most extensively used in vitro label for blood cells, has a wide scope of applications ranging from survival studies of circulating cells to the measurement of antibody action. As with other cell labels it also has limitations which have raised numerous discussions with regard to blood platelets. Accurate interpretation of results obtained with artificial cell markers depends upon a complete understanding of their labeling characteristics. Very few of these are known for the labelling of platelets with chromate. In a series of investigations, we have elucidated distribution and binding sites of chromate within the platelets, its mechanism and kinetics of transport, and its uptake as a function of cell age. (auth)

880 NATURAL URANIUM AND RADIUM-226 CONTENT OF HUMAN BONES IN SOME REGIONS OF BULGARIA. Estimation of Exposure Radiation Doses. Janackova, M.; Dermendziev, H.; Zlatanova, R. Letop. Khig. Epidemiol. Inst.; 5: No. 36, 42-49 (1971). (In Bulgarian).

Eighty-four bone samples from 3 districts (Sofia, Stara Zagora, and Rousse) were examined in an effort to determine natural uranium and radium-226 concentrations. The bones originated from individuals of all age groups, from neonates to 86 year-old persons. Different bones were examined: breastbone, ribs, skull, spinal column, long bones, and whole bone frames. Natural uranium and radium-226 concentrations were determined by use of a radiochemical technique: uranium by the extraction-luminescent method and visual reading of tests under ultraviolet light, and radium-226 by the emanation method. It was found that the concentration of natural uranium in the ribs is twice as high in Stara Zagora district and 4½ times higher in Rousse district, as compared to Sofia district. The concentration of radium-226 in the ribs ranges from $0.91.10^{-13}$ Ci/g to 11.10^{-13} Ci/g for the three districts. The concentrations of natural uranium and radium-226 in the human bones for all three districts are close to those in other countries. (Abstr. Bulg. Sci. Med. Lit.)

881 METHOD OF MONITORING FOR INTERNAL CONTAMINATION OF THE STAFF IN THE INSTITUTE OF NUCLEAR RESEARCH, BASED ON THE MEASUREMENTS OF RADIATION EMITTED BY THE ORGANISM. Cwik, T.; Deszczak, T. (Inst. of

Nuclear Research, Warsaw). Probl. Tech. Med.; 4: 311-316(1973). (In Polish).

The general parameters of equipments and the measurement methods used in the Institute of Nuclear Research for the determination of internal contamination of the staff by gamma radiation emitters are presented. The monitoring program in such cases is discussed together with measurement methods. (auth)

882 STUDY OF THE NATURAL HISTORY OF HOT THYROID NODULES. Landgarten, S.; Spencer, R. P. (Yale Univ., New Haven). Yale J. Biol. Med.; 46: No. 4, 259-263(Oct 1973).

As judged by an area of increased uptake on a thyroid scan, 133 cases were selected. Thirty-seven percent of these had prior surgery on the neck and another 11% were judged to be due to thyroiditis or other miscellaneous causes. The remaining cases were divided into two classes, depending on whether the thyroidal radioiodide uptake value was above or below rather stringent criteria. Evidence was presented that there was little movement from the group with "normal" radioiodide uptake values into the hyperthyroid range. On the basis of this finding, and the benign nature of the lesions found in 10 patients who did undergo thyroid surgery, it was concluded that the hot nodules are relatively benign and that conservative management is likely indicated. (auth)

Animals

Refer also to abstracts 544–549, 766, 846, and 922.

883 (BNWL-1850(PT1), pp 4-5) PLUTONIUM METABOLISM IN THE LACTATING RAT. Mahlum, D. D.; Sikov, M. R. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Pregnant rats of 21 days of gestation and nulliparous rats were injected with ^{239}Pu citrate and killed 1 or 7 days later. The lactating rats had higher levels of Pu in the uterus and mammary glands than did the nonlactating animals. The reverse was true in the case of blood, ovaries, pituitary, and pancreas. (auth)

884 (BNWL-1850(PT1), pp 5-6) PLUTONIUM METABOLISM IN IMMATURE SWINE. McClanahan, B. J.; Ragan, H. A.; Mahlum, D. D. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Newborn and weanling miniature pigs injected intravenously with monomeric ^{239}Pu exhibited a similar distribution and retention pattern with the exception of liver. Initially, the newborn liver had a ^{239}Pu level equivalent to one-third that in the weanling liver. At the end of 28 days it had increased threefold while the weanling liver increased 30%. (auth)

885 (BNWL-1850(PT1), pp 11-12) INFLUENCE OF BARBITURATES OR RESTRAINT ON PLUTONIUM-238 EXCRETION OR REMOVAL. Sullivan, M. F. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Rats injected with ^{238}Pu and bile-duct-cannulated were subjected to restraint and daily treatment with a long-acting barbiturate, sodium phenobarbital. Restraint had no effect on either excretion or retention of plutonium. Phenobarbital increased bile volume and non-biliary excretion of Pu. This resulted in decreased retention in both bone and liver, but the effect was not substantial. (auth)

886 (BNWL-1850(PT1), pp 13-14) ENHANCED PLUTONIUM ABSORPTION BY IRON-DEFICIENT MICE. Ragan, H. A. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

The intestinal absorption and retained body burden of ^{239}Pu citrate administered by gastric intubation was significantly greater in adolescent iron-deficient mice than in iron-replete mice. (auth)

887 (BNWL-1850(PT1), pp 15-17) ABSORPTION OF CURIUM-244 AND CALIFORNIUM-252 FROM THE GASTROINTESTINAL TRACT OF NEWBORN AND ADULT RATS. Sullivan, M. F. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

The absorption of $^{244}Cm(NO_3)_3$, $^{244}Cm_2O_3$, and $^{252}Cf(NO_3)_3$ from the gastrointestinal tract of adult rats was 0.15, 0.12, and 0.11%, respectively, of the administered dose. Gastrointestinal absorption by newborn rats after ^{244}Cm or ^{252}Cf was 6.3 and 4.4%. (CH)

888 (BNWL-1850(PT1), pp 45-46) TISSUE DISTRIBUTION IN DOGS AFTER INHALATION OF $^{238}Pu^{16}O_2$ (PPO) AND $^{238}Pu^{16}O_2$ Mo CERMET (PMC). Park, J. F.; Craig, D. K.; Catt, D. L.; Olson, R. J. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

More than 95% of the Pu was retained in the lungs and thoracic lymph nodes of dogs exposed to $^{238}Pu^{16}O_2$ and $^{238}Pu^{16}O_2$ Mo cermet during the 90-day post-inhalation period with less than 3% retained in the liver and skeleton. The fraction of plutonium in the liver and skeleton of the PMC dogs was about twice that in the PPO-exposed group. (auth)

889 (BNWL-1850(PT1), pp 49-51) ALVEOLAR DEPOSITION OF INHALED PLUTONIUM AEROSOLS IN RODENTS. Craig, D. K.; Buschbom, R. L.; Ballou, J. E.; Sanders, C. L.; Herring, J. P.; Hadley, J. P.; McDonald, K. E.; Tombropoulos, E. G. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Analysis of the data from a large number of different inhalation studies involving the nose-only radioactive aerosol exposure of rodents has failed to yield any consistent significant correlations between percentage alveolar deposition and the various aerosol and exposure condition parameters that were measured. The most useful finding was a very high correlation between alveolar deposition and aerosol concentration of inhaled quantity of material. (auth)

890 (BNWL-1850(PT1), pp 51-53) RELATIVE QUANTITY OF AIRBORNE PLUTONIUM DEPOSITED IN THE RESPIRATORY TRACT AND ON THE SKIN OF RATS. Craig, D. K.; Mahlum, D. D.; Klepper, E. L.; Herring, J. P.; Powers, G. J. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Shaved rats were exposed to a $^{238}Pu(NO_3)_4$ aerosol in a low speed windtunnel. Immediately after exposure, about 40% of the inhaled material was in the lower respiratory tract, about 40% in the upper respiratory tract, and 20% in the intestines. Plutonium deposited on the skin amounted to about one-fourth of the amount initially deposited in the respiratory tract. Measured values agreed with calculated values within a factor of two. (auth)

891 (BNWL-1850(PT1), pp 54-56) EARLY FATE OF INHALED $^{238}PuO_2$, $^{239}PuO_2$, AND $^{244}CmO_x$ IN RATS. Sanders, C. L.; Craig, D. K.; Smith, V. H. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Inhaled $^{239}PuO_2$ in rats was cleared from the lung and excreted in the feces, while inhaled aged $^{238}PuO_2$ or $^{244}CmO_x$ showed much greater translocation to liver and bone. Fresh $^{238}PuO_2$ showed greater in vivo solubilization than did $^{239}PuO_2$, while fresh $^{244}CmO_x$ was highly soluble in the lung. (auth)

892 (BNWL-1850(PT1), pp 64-65) CLEARANCE OF PuO_2 FROM MEDIASTINAL LYMPH NODES. Sanders, C. L. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Plutonium-239 dioxide was translocated from the peritoneal cavity to the mediastinal lymph nodes of rats. Significant clearance of PuO_2 was observed from these lymph nodes with an estimated half-life of about 1 year. No tumors developed from these PuO_2-laden lymph nodes. (auth)

893 (BNWL-1850(PT1), pp 65-67) EARLY DISPOSITION OF INHALED PLUTONIUM AND EINSTEINIUM IN THE RAT. Ballou, J. E. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

The early postexposure urinary excretion of inhaled ^{238}Pu, ^{239}Pu, and ^{253}Es compounds in rats appears to be influenced by the radiation dose to the lung. The rate of lung clearance, on

the other hand, appears to be related to the mass of material deposited. Lung burdens of less than 1 nCi plutonium were cleared most rapidly with relatively large amounts excreted in urine during the first week after inhalation exposure. (auth)

894 (BNWL-1850(PT1), pp 68-69) DISPOSITION OF INHALED AND INTRATRACHEALLY INSTILLED ^{253}Es IN RATS. Ballou, J. E. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

The pattern of lung clearance and translocation to bone was similar for intratracheally instilled $^{253}EsCl_3$, inhaled $^{253}Es(NO_3)_3$, and inhaled $^{253}Es(OH)_3$. Instilled $Es(OH)_3$, given at pH 12, was more rapidly cleared and deposited less in bone. The long-term biological effects of inhaled and instilled ^{253}Es are expected to be about the same in bone, but may be different in lung because of differences in lung dose distribution. (auth)

895 (BNWL-1850(PT1), pp 76-77) PRELIMINARY INVESTIGATIONS WITH INHALED ^{85}Kr IN THE RAT AND BEAGLE DOG. Ballou, J. E.; Cannon, W. C. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Preliminary efforts to develop techniques for studying the inhalation toxicology of radioactive gases are summarized. Results are shown for rats and dogs exposed by nose only inhalation of an atmosphere containing ^{85}Kr. (auth)

896 (BNWL-1850(PT1), pp 77-79) FATE OF INHALED HIGH-FIRED BERYLLIUM OXIDE IN RATS AND HAMSTERS. Sanders, C. L.; Cannon, W. C.; Powers, G. J.; Adee, R. R. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Rats and hamsters were exposed to aerosols of high-fired BeO. The BeO particles were rapidly phagocytized by alveolar macrophages, which showed marked structural alterations; other pulmonary cells were not affected. BeO was tenaciously retained in the lung, less than 20% of the alveolar deposit being cleared in 63 days. (auth)

897 (BNWL-1850(PT1), pp 85-87) ELEMENTAL CHARACTERIZATION OF ANIMAL TEST CHAMBERS AND URANIUM MINE AEROSOLS. Cooper, J. A. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

The elemental compositions of air samples from uranium mines and from experimental animal inhalation chambers were determined as a function of particle size. The contributions of uranium ore handling, uranium ore dusts, diesel engine exhaust fumes, blasting, and welding to aerosol formation in uranium mines were determined. (CH)

898 (BNWL-1850(PT1), pp 89-91) COMPARATIVE EFFECTS IN HAMSTERS, RATS, AND MICE OF EXPOSURE TO SIMULATED URANIUM MINE ATMOSPHERES. Palmer, R. F.; Stuart, B. O.; Filipy, R. E. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Hamsters, rats, and mice were chronically exposed to 2000 to 8500 WL of radon daughters, with and without uranium ore dust, to provide an interspecies comparison of the effects of these uranium mine inhalation hazards. (auth)

899 (BNWL-1850(PT1), pp 102) QUANTIFICATION OF INHALED PROMETHIUM. Nelson, I. C.; Ballou, J. E.; Griffin, B. I.; Craig, D. K. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Human data on the retention of inhaled promethium are badly needed for diagnosing the retention of $^{147}Pm_2O_3$ in accidentally exposed workers. Exposure of human volunteers to the readily detectable ^{143}Pm seems feasible, providing a suitable carrier can be found that will provide the necessary mass and that will behave like promethium in the human body. Samarium has been proposed as such a carrier and experiments comparing the behavior of intravenously injected and inhaled samarium and promethium in rats indicated that, for a reasonable time after exposure, samarium is suitable as a carrier for promethium. A similar experiment was performed in which a mixed promethium-samarium oxide aerosol was inhaled by beagle dogs. Evaluation of tissue distribution and excretion data from this experiment has not been completed. If these data confirm the earlier results obtained with rats, plans will be made for exposure of human volunteers to a ^{143}Pm, samarium oxide-carried aerosol. (auth)

900 (BNWL-1850(PT1), pp 106-107) COMPARATIVE EFFECTIVENESS OF INHALED AND INJECTED Ca- OR Zn-DTPA FOR REMOVING INTRAMUSCULARLY DEPOSITED $^{238}Pu(NO_3)_4$ FROM THE RAT. Smith, V. H. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Under conditions simulating those encountered by man in industrial accidents, inhaled DTPA was as effective as intraperitoneally injected DTPA in removing intramuscularly deposited $^{238}Pu(NO_3)_4$ from the rat. The zinc salt, under the prompt treatment conditions tested, was not as effective as the calcium salt. (auth)

901 (BNWL-1850(PT1), pp 111-112) TOXICITY OF INHALED DTPA. Smith, V. H. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

No significant gastrointestinal pathology was seen in rats during or following inhalation of Ca-DTPA at daily dose levels up to 20 times those normally taken by man for radionuclide removal from tissues and for up to 20 consecutive days. Even at these high levels the inhalation route seems unable to maintain systemic levels of DTPA sufficiently high to produce the gastrointestinal syndrome seen following continuous infusion. As previously noted, a transient vesicular emphysema was produced that generally was not present 3 weeks after cessation of treatment. (auth)

902 (BNWL-1850(PT1), pp 112-114) REMOVAL OF INTRAMUSCULARLY INJECTED ^{238}Pu-NITRATE FROM THE RAT BY CONTINUOUS INFUSION OF CHELATING AGENTS. Sullivan, M. F.; Smith, V. H. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Under prompt treatment conditions continuous infusion of EDTA or DTPA showed little therapeutic advantage over rapidly administered, single, daily treatments. Due to the greater toxicity of continuously infused Ca-DTPA, procedures sustaining that agent in the system overly long should be considered potentially hazardous. (auth)

903 (BNWL-1850(PT1), pp 114-117) TOXICITY OF CONTINUOUSLY MAINTAINED LEVELS OF CHELATING AGENTS IN THE RAT AND MINIATURE SWINE. Sullivan, M. F.; Mahony, T. D.; Ragan, H. A.; Lund, J. E.; Hackett, P. L.; Beamer, J. L.; Smith, V. H. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

At dose levels employed in humans and under the special conditions of maintaining constant levels of the chelating agents, Ca-DTPA and Ca-EDTA were toxic in both the rat and miniature swine. Effects were particularly evident in the gastrointestinal tract and bone marrow. These effects are not seen when the chelate is administered over a short time span. Zn-DTPA was much less toxic than the Ca salt. (auth)

904 (BNWL-1850(PT1), pp 118-120) CHELATABILITY OF PLUTONIUM AND EINSTEINIUM IN BLOOD. Ballou, J. E. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

Compared to trivalent actinides, tetravalent ^{239}Pu citrate was relatively slowly cleared from blood of dogs, whether given intravenously or by intratracheal instillation; 50 to 80% of the Pu in blood, as long as 3 hr after administration, was ultrafilterable in the presence of added DTPA. Einsteinium-253 nitrate, a trivalent actinide, was even more readily chelatable in blood. However, due to rapid translocation, only a small fraction of the dose was available in blood after 3 hr. These results indicate the importance of blood clearance kinetics to the success of DTPA therapy. (auth)

905 (COO-3140-22) TOXICOLOGY AND METABOLISM OF NICKEL COMPOUNDS. Progress Report. Sunderman, F. W. Jr. (Connecticut Univ., Farmington (USA). School of

Medicine). 1 Aug 1974. Contract AT(11-1)-3140. 21p. Dep. NTIS $4.25.

The toxicology and metabolism of nickel compounds ($NiCl_2$, $NiSO_4$, Ni_3S_2) were investigated in rats and rabbits. The new knowledge has included: understanding of nickel-induced hyperglycemia, based upon establishment of dose-response relationships, comparison of hyperglycemic responses of divalent ions of first transition metals, observation of effects of adrenalectomy and hypophysectomy, and measurements of serum insulin during Ni(II)-induced hyperglycemia; discovery of localization of ^{63}Ni in pituitary of rabbits after injections of $^{63}NiCl_2$. This finding may have physiological importance in view of recent reports that administration of Ni(II) to rats depresses release of pituitary prolactin; demonstration of ultrafiltrable nickel complexes in rabbit serum after $^{63}NiCl_2$ injection, based upon fractionations of serum ultrafiltrates by thin-layer chromatography and autoradiography; improvement of methods for analysis of nickel and other trace metals by non-flame atomization for atomic absorption spectrometry, and by use of teflon combustion bombs for preliminary digestion of solids; substantiation of the value of hair sampling in evaluation of environmental exposures to nickel. Confirmation that Ni_3S_2 carcinogenicity in rats is depressed by simultaneous injection of Mn dust, and demonstration that this effect is not the result of increased local inflammatory reaction or increased rates of elimination of nickel in urine or feces. (auth)

906 (IAEA-163, pp 55-62) ELEMENTAL CONCENTRATION OF ZOOPLANKTON AND THEIR PARTICULATE PRODUCTS. Fowler, S. W.; Oregioni, B. Jun 1974.

Since zooplankton fecal pellets and molts have been shown to be major vectors in the vertical transport of zinc in the sea, analyses were made for other trace metals in these particulate products. Euphausiids and pelagic shrimp were collected live off the Monaco coast. Samples of microplankton, which serve as food for the macroplankton, were also taken at the same time. Natural fecal pellets and molts collected in the labatory were analyzed for content of Ag, Cd, Co. Cr, Cu, Fe, Mn, Ni, Pb, Zn, Ce, Cs, Eu, Sb, Sc, Se, and Sr. (CH)

907 (IAEA-163, pp 119-125) TRACE ELEMENT CONCENTRATIONS IN MUSSELS OF THE LIGURIAN SEA. Fowler, S. W.; Oregioni, B.; LaRosa, J.; Renfro, W. C. Jun 1974.

Information is accruing on the heavy metal content of many marine molluscs in various areas of the world, however, there is a definite lack of data for species in the Mediterranean Sea, a semienclosed body of water where pollution effects may be magnified. Results are reported from a survey initiated to establish baseline levels of metals in a single marine species of widespread ecological importance, the mussel, Mytilus galloprovincialis, and to assess the effect of spatial and seasonal variation on the level of these metals along the Ligurian coast. (auth)

908 TOXICITY OF ^{144}Ce INHALED AS $^{144}CeCl_3$ BY THE BEAGLE: METABOLISM AND DOSIMETRY. Boecker, B. B.; Cuddihy, R. G. (Lovelace Foundation for Medical Education and Research, Albuquerque, NM). Radiat. Res.; 60: No. 1, 133-154 (Oct 1974).

Twenty-seven beagles were individually exposed by inhalation to $^{144}CeCl_3$ in a CsCl vector aerosol (Activity Median Aerodynamic Diameter ~1.5-2.2 μm) for 4 to 10 min yielding initial body burdens of 1.6-4.4 μCi ^{144}Ce/kg body weight. Of the ^{144}Ce activity inhaled, an average of 71% (range = 51% to 94%) was deposited in the total body and an average of 35% (range = 13% to 55%) was associated with long-term retention. The behavior of the inhaled ^{144}Ce was followed by whole-body counting, excreta collections, and tissue analyses following serial sacrifice of groups of three dogs from 2 to 512 days after exposure. After an early clearance from the upper respiratory tract, most of the remaining body burden was retained with an effective half-life similar to the physical half-life of ^{144}Ce, 284 days. As ^{144}Ce was absorbed from the lung, it was deposited primarily in liver and skeleton; maximum tissue burdens were observed at 8 days after exposure. An analog model describing the metabolic behavior of ^{144}Ce inhaled in this form by beagles was used to calculate tissue doses. A long-term retained burden of 1.0 μCi ^{144}Ce/kg body weight in a beagle resulted in potential infinite doses to liver, lung, and skeleton of 220, 90, and 67 rads, respectively. Direct extrapolation of these results to humans indicates that the limiting maximum permissible annual intake based on 15 rem/year and a pulmonary deposition of 20% is that for liver, 13 μCi. This results in an average occupational air concentration that is one-half the maximum permissible concentration in air currently recommended for ^{144}Ce inhaled in a soluble form. (auth)

909 DISTRIBUTION AND TOXICITY OF MONOMERIC AND POLYMERIC ^{239}Pu IN IMMATURE AND ADULT RATS. Mahlum, D. D.; Sikov, M. R. (Battelle Pacific Northwest Labs., Richland, WA). Contract AT(45-1)-1830. Radiat. Res.; 60: No. 1, 75-88 (Oct 1974).

Newborn (0-24 hr old), weanling (21 days old), and adult (4 mo old) rats were injected intravenously with doses of monomeric or polymeric ^{239}Pu over the range of 6-90 μCi/kg. Some animals from each age-dose-form group were killed at intervals for determination of distribution and retention while the remaining rats were held for observation of acute mortality and several measures of delayed change. The most notable difference in partition involved a failure of the newborns to differentiate between the two physicochemical forms and an increased skeletal deposition in the weanlings exposed to monomer. As a result of these differences in deposition, as well as differences in retention and dilution, the cumulative radiation doses differed for the three ages. On an injected dose basis, monomeric ^{239}Pu was more acutely toxic to newborn rats, $LD_{50/30}$ = 63 μCi/kg, than to adult or weanling rats, $LD_{50/30}$ = >90 μCi/kg. Polymeric ^{239}Pu was more acutely toxic to adult and weanling rats, $LD_{50/30}$ = 47 μCi/kg, than to newborn rats, $LD_{50/30}$ = 77 μCi/kg. Delayed deaths, between 90 and 270 days after injection, were more frequent among adults injected with monomeric ^{239}Pu at levels of 6-90 μCi/kg (14/41, 90-day survivors) than among adults injected with polymeric ^{239}Pu (6/25, 90-day survivors) or among either weanling or newborn rats given either form of ^{239}Pu. Delayed effects such as mortality and mammary tumor incidence appeared to be influenced by the pattern of radiation doses associated with the physicochemical form administered and the age at exposure. (auth)

910 KINETICS OF METABOLISM OF ^{239}Pu IN THE LIVER. Shvydko, N. S. Med. Radiol.; 19: No. 10, 71-72(Oct 1974). (In Russian).

The kinetics of ^{239}Pu metabolism in the liver were studied. Previously obtained data on the chemical state of ^{239}Pu in the liver were used to explain the exchange parameters of this element. Study of the kinetics of exchange with individual components showed that in the period from 2 to 168 hrs after intraperitoneal injection of ^{239}Pu citrates there occurs an abrupt redistribution of the radioelement. The results obtained indicate that in the first hour after injection most of the ^{239}Pu accumulated in the liver is absorbed by extracellular liver surfaces. The fixation is determined by strong electrostatic adsorption and chemical interaction. The greatest part of the adsorption bound ^{239}Pu is labile with $T_{\frac{1}{2}}$ = 20 hrs. It is then transported within the cells combining itself with ferritin. The rate of decontamination of the liver is determined by the elimination of ^{239}Pu from the ferritin. (JSR)

911 EXCRETION OF RADIONUCLIDES BY RATS FOLLOWING ^{232}Th INTAKE BY RESPIRATORY ORGANS. Pavlovskaya, N. A.; Makeeva, L. G.; Zel'tser, M. R. Gig. Sanit.; No. 9, 42-45(1974). (In Russian).

The finding was that ^{224}Ra is excreted much more intensively than ^{228}Th and that the investigated radionuclides of the row of ^{232}Th are excreted in feces in two phases. The rate of ^{224}Ra excretion in feces amounts to ~1.5% and ~3% in case of intake of insoluble and soluble thorium compounds. (auth)

912 DISTRIBUTION, ACCUMULATION, AND ELIMINATION OF ^{90}Sr AND ^{137}Cs IN CATTLE AND WILD ANIMALS. Vokken, G. G. pp 232-239 of Primenenie Izotopov i Yadernykh Izluchenii v Sel'skom Khozyaistve. III. Moscow; Atomizdat (1971). (In Russian)

Studies on the distribution, accumulation, and elimination of ^{90}Sr and ^{137}Cs in domesticated and wild animals showed nonuniform distribution of ^{90}Sr in the skeletons. The maximum concentration in all age groups was in the jaw, and the minimum was in the epiphysis of the metacarpals and in horny processes in young animals. With age the ^{90}Sr distribution in the skeleton became more uniform. Tests showed that the ^{90}Sr concentration in the skeleton of cattle was not affected by the height of the pasture above sea level but was affected by the level of radioactive fallout. Strontium-90 in cattle teeth was also studied. The level of ^{137}Cs was found to be higher in the organs of cattle than in guinea pigs and dogs. The radioecology of three kinds of deer (moose, noble deer, and fawns) was studied. The output of ^{90}Sr and ^{137}Cs in milk and transfer to milk products and the output of ^{90}Sr in hens' eggs were determined. The ^{90}Sr transfer from milk to milk products depended on the pH of the original milk, on the processing technique used and the product yield, and on the product fat and moisture content. Of the ^{90}Sr in the feed, 14% appeared in the shell, and one shell contained 11% of that in the whole skeleton. (INIS)

913 ^{65}Zn UPTAKE IN TESTES AND ACCESSORY SEX GLANDS DURING PHASES OF SEXUAL AROUSAL AND QUIESCENCE IN THE INDIAN HEDGEHOG. Kanwar, K. C.; Singh, A.

(Panjab Univ., Chandigarh, India). Indian J. Exp. Biol.; 12: No. 2, 206-207(Mar 1974).

Variations in ^{65}Zn uptake in testes, epididymis, seminal vesicles, and prostate of the Indian male hedgehog, H. auritus collaris, during phases of sexual arousal and quiescence have been studied. (auth)

914 UPTAKE OF $^{65}Zn^{++}$ AND $^{59}Fe^{+++}$ BY ISOLATED RAT LIVER MITOCHONDRIA. Gary, D. P.; Dubey, D. P.; Gupta, G. S. (Punjab Univ., Chandigarh, India). Indian J. Exp. Biol.; 12: No. 2, 169-171(Mar 1974).

Isolated rat liver mitochondria were incubated in a buffered sucrose medium containing $MgCl_2$, glutamate and $^{59}Fe^{+++}$ or $^{65}Zn^{++}$ in presence or absence of ATP. Addition of ATP in the range of 20 to 50 μM enhances the uptake of $^{59}Fe^{+++}$ and $^{65}Zn^{++}$ by these organelles. Presence of glutamate (300 to 600 μM) showed results similar to ATP, though the presence of ATP and glutamate was not obligatory. It is concluded that the uptake of iron and zinc by mitochondria involves energy dependent as well as energy independent processes. (auth)

915 BONE-SEEKING RADIONUCLIDES: AN IN VIVO STUDY OF FACTORS AFFECTING SKELETAL UPTAKE. Genant, H. K.; Bautovich, G. J.; Singh, M.; Lathrop, K. A.; Harper, P. V. (Univ. of Chicago). Cancer, Suppl.; 113: No. 2, 373-382 (Nov 1974).

From 39th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (25 Nov 1973).

The factors governing the skeletal uptake of bone-seeking radionuclides in vivo have not been clearly defined. In this study, the effects of alteration in blood flow (thermal-induced) and alteration in osteogenesis (ricket-induced) on the skeletal uptake of these agents in rats were investigated. In vivo quantitative data were corroborated by the use of autoradiographic and well-counting techniques. Results indicate that the short-term uptake of commonly used bone-scanning agents is closely correlated with blood flow and is largely independent of the rate of osteogenesis. (auth)

Plants

916 ACCUMULATION OF MICRO- AND NATURAL RADIOACTIVE ELEMENTS IN SOME MOSS AND LICHEN SP. OCCURRING IN BULGARIA. Gorbanov, S.; Khadzhiatanasov, D. Nauch. Tr., Vissh Selskostop. Inst., Plovdiv; 22: 29-37(1973). (In Bulgarian).

The ability of country moss and Lichen species to accumulate microelements such as Mo, Ni, Mn, Cu, Zn, and Fe and natural radioactive elements was studied. It was ascertained that all of them accumulate natural radioactive elements, Mo, and Cu, while the content of Mn, Zn, Ni, and Fe is either equal or lower than that of the rock on which the respective species develop. The coefficient of biological accumulation is high for rocks poorer in the enumerated elements. (INIS)

917 RADIOECOLOGY OF SOME BLUEGREEN ALGAE. Manilal, K. S. (Univ. of Calicut, Kerala, India). Curr. Sci. (India); 43: No. 20, 641-643(20 Oct 1974).

The bluegreen algae Anacystis nidulans and Anabaena floaquae absorb thorium by a passive process when the chemical is present in the medium. However, the two species differ significantly from each other in their capacity to absorb and accumulate the radiochemical, the effect of light on absorption, the highest concentration factor attained, etc., thereby showing that it is not safe to make generalized predictions about the reactions of any one radiochemical with regard to even closely related species of organisms. (auth)

918 COMPARISON OF PLANT INJECTION AND LEAF SMEARING TECHNIQUES WITH ^{32}P FOR ROOT DISTRIBUTION STUDIES OF BAJRA (PENNISETUM TYPHOIDES STAPF.). Shriniwas, S. B. V. (IARI, New Delhi). Indian Soc. Nucl. Tech. Agr. Biol., Newslett.; 2: No. 1, 42-45(1973).

This investigation was carried out to find the applicability of ^{32}P plant injection and leaf smearing techniques for root distribution studies of bajra. In sand culture studies with two bajra varieties at two stages (50 and 70 days after sowing) and 3 periods of sampling (2, 5 and 8 days after application of the ^{32}P activity), specific activity values of different root sections showed an unequal distribution of activity up to 5 days. The equilibrium was attained after 8 days period in all the treatments. ^{32}P plant injection technique was found better than leaf smearing technique in respect to percentage of activity transported to the roots. However, the leaf smearing technique offers some advantages in the root kinetic studies. (Indian Sci. Abstr.)

New Tracer Techniques

Refer also to abstracts 78, 149, 176, 552, 568, 588, 666, 821, 879, and 905.

919 (AED-CONF-73-113-001) FORMATE DEHYDROGENASE FROM PSEUDOMONAS OXALATICUS: CATALYSIS OF CARBONATE REDUCTION TO FORMATE BY NADH. Hoepner, T.; Ruschig, U.; Mueller, U. (Heidelberg Univ. (F. R. Germany). Inst. fuer Biologische Chemie). 1973. 10p. (CONF-730369-1).

From winter meeting of the Gesellschaft fuer Biologische Chemie; Konstanz, F. R. Germany (11 Mar 1973).

The formate: NAD oxidoreductase reaction catalyzed by formate dehydrogenase from Pseudomonas oxalaticus is reversible. The enzyme catalyzes the carbonate (carbon dioxide) reduction to formate by NADH as proved by the characterization of the reduction product from ^{14}C-carbonate by NADH and by the carbonate dependent oxidation of NADH. As a partial reaction of the reduction the enzyme catalyzes the NAD(H) independent carbonate formate exchange. The isolation and purification of the enzyme from the bacterium are described. (GE)

920 (AED-CONF-73-482-002) EXPERIMENTALLY DETERMINED DOSE RATES FOR SOME RADIONUCLIDES OF INTEREST IN NUCLEAR MEDICINE. Taegder, K.; Junker, D.; Schmitz-Feuerhake, I. (Medizinische Hochschule Hannover (F. R. Germany). Inst. fuer Nuklearmedizin und Spezielle Biophysik). 1973. 7p. (In German). (CONF-731089-1).

From 4th scientific meeting of the Deutsche Gesellschaft fuer Medizinische Physik; Homburg/Saar, F. R. Germany (4 Oct 1973).

A method permitting the measurement of dose rates of incorporated radionuclides is described. Neither physical data concerning the decay nor a good knowledge of the decay scheme is necessary. With the help of liquid scintillation counters the following radionuclides are studied: ^{51}Cr, ^{75}Se, ^{85}Sr, ^{131}I, ^{197}Hg, ^{198}Au, ^{203}Hg. (GE)

921 (ANL-8096, pp 56-58) NUCLEAR MEDICAL ISOTOPE RESEARCH. Apr 1974.

In Chemistry Division annual report, July 1972–June 1973.

Work in progress includes: evaluation of ^{52}Fe as a hemapoietic marrow scanning agent, preparation and use of a $^{81}Rb-^{81m}Kr$ generator for organ visualization and perfusivity studies, and experimental animal studies of actinide and lanthanide tumor-specific compounds. (MCG)

922 (BNWL-1850(PT1), pp 108-110) DISTRIBUTION AND RETENTION OF INHALED DTPA. Smith, V. H. Aug 1974.

In Pacific Northwest Laboratory annual report for 1973 to the USAEC Division of Biomedical and Environmental Research. Part 1. Biological sciences.

The rate of appearance in rat urine of inhaled $CaNa_3DTPA$ and $ZnNa_3DTPA$ was retarded compared with the intravenously administered material. No difference between the Zn and Ca salt was statistically verified. Assuming that urinary excretion mimics blood levels, inhaled DTPA should be available for metal decorporation over longer time periods than DTPA intravenously injected. (auth)

923 (CONF-740708-41) DIFFERENTIAL MULTI-LEVEL DISPLAY: A NEW METHOD FOR EVALUATING DYNAMIC SCINTICAMERA STUDIES. Runczik, L.; Cernoch, V.; Vavrejn, B.; Jirickova, E.; Kidery, J. (Institut pro Klinickou a Experimentalni Medicinu, Prague (Czechoslovakia)). 1974. 8p. (SM-185/76). Dep. NTIS (US Sales Only) $4.00.

From Symposium on dynamic studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

The differential multi-level display offers a very powerful means of evaluating the dynamic process. The motion of the radioactivity in the field of view of the camera is presented quantitatively and in a highly illustrative form. (auth)

924 (CONF-741018–, pp 129-142) OVERVIEW OF ALTERNATIVES TO ^{131}I USE FOR THYROID DIAGNOSIS. Paras, P. (Bureau of Radiological Health, Rockville, MD). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population exposures.

The largest organ absorbed radiation dose in nuclear medicine is approximately 200 rads (100 μCi) to the thyroid for an ^{131}I scanning procedure. Radiation doses of 200 rads or more were associated with significantly greater incidence of thyroid adenoma and carcinoma. It is also known that children's thyroids are both more radiosensitive than the adult's and receive a higher absorbed dose per μCi administered. Recent published data show that x-ray doses as low as 4-10 rads to children's thyroids and upper parts of the body are capable of inducing a higher rate of both benign and malignant thyroid tumors 10-20 years after exposure. Alternatives to the use of ^{131}I will be discussed with emphasis on ^{123}I (γ = 159 keV; $T_{\frac{1}{2}}$ = 13 hrs) which has unique

properties for scanning. Low energy cyclotrons can produce moderate amounts of ^{123}I contaminated with ^{124}I (~1%) resulting in a delivered dose to the thyroid of approximately 6 rads per scanning procedure. High purity ^{123}I produced by the ^{123}Xe decay route results in a dose to the thyroid of less than 3 rads per scanning procedure. In addition to the marked dose reduction—a factor of 70—high purity ^{123}I produces superior images to those obtained with ^{131}I. Technetium-99m pertechnetate (γ = 140 keV; $T_{\frac{1}{2}}$ = 6 hrs) although readily available is not a suitable replacement for iodine. Technetium is not organified by the thyroid and does not give a true picture of iodine metabolism. Although the absorbed dose is 0.5 rad (1 mCi) per scanning procedure, the background activity in the neck is relatively high and can significantly alter the scan quality, particularly in low uptake cases. The production, availability and associated problems as well as comparison studies of ^{131}I with ^{99m}Tc and ^{123}I both in high purity and slightly contaminated form will be discussed. (auth)

925 (IAEA-163, pp 90-93) PLUTONIUM-237 AS A TRACER IN PLUTONIUM BIOGEOCHEMICAL EXPERIMENTS. Fukai, R. Jun 1974.

Laboratory experiments using α-emitting radionuclides of Pu (^{236}Pu, ^{238}Pu, $^{239,240}Pu$) suffer two distinct disadvantages: health safety requirements limit the quantities which can be used at any one time and radiochemical separations are both demanding and time consuming. However, one isotope of plutonium, ^{237}Pu, obviates these difficulties. The isotope decays by electron capture (99%); α particle emission being less than 0.002%. The characteristic x rays of ^{237}Np that result from the decay of the parent ^{237}Pu are of reasonably high energy (≈ 100 keV) and can be measured with NaI(Tl) scintillation crystals with good efficiency. The fluorescence yield is > 95% and internal conversion of the neptunium x ray is not large. The isotope decays with a half life of approximately 45 days which allows reasonable time for experimentation. This isotope clearly has great utility for institutions engaged in research dealing with the environmental behavior of Pu. (CH)

926 (STI/PUB-350(Vol.1)) RADIOIMMUNOASSAY AND RELATED PROCEDURES IN MEDICINE. Volume I. Proceedings Series. Proceedings of a Symposium Held at Istanbul, Turkey September 10-14, 1973. (International Atomic Energy Agency, Vienna (Austria)). Mar 1974. 484p. (In French and English). (CONF-7309119-(P1)). IAEA $20.00.

Separate abstracts were prepared for the 34 papers presented in volume I of these proceedings. (ERB)

For abstracts of individual papers see: 947-980.

927 (STI/PUB-350(Vol.2)) RADIOIMMUNOASSAY AND RELATED PROCEDURES IN MEDICINE. Volume II. Proceedings Series. Proceedings of a Symposium Held at Istanbul, Turkey, September 10-14, 1973. (International Atomic Energy Agency, Vienna (Austria)). May 1974. 446p. (In French and English). (CONF-7309119-(P2)). IAEA $20.00.

Separate abstracts were prepared for the 34 papers presented in volume II of these proceedings. (ERB)

For abstracts of individual papers see: 981-1014.

928 DOUBLE LABEL AUTORADIOGRAPHY. Gruenstein, E.; Smith, T. W. (Massachusetts Inst. of Tech., Cambridge). Anal. Biochem.; 61: No. 2, 429-433(Oct 1974).

A method is described for double autoradiography of thin-layer chromatograms. The method relies on the ability to increase the sensitivity of ^{3}H detection following treatment of the chromatography plate with a scintillation fluor without simultaneously increasing the sensitivity to ^{14}C. At ratios of ^{3}H to ^{14}C radioactivity equal to 60 to 1, there is little or no spillover in the detection of these radioisotopes. (auth)

929 USE OF A RADIOIMMUNOASSAY FOR ALPHA-FETOPROTEIN IN THE DIAGNOSIS OF MALIGNANCY. Waldmann, T. A.; McIntire, K. R. (National Cancer Inst., Bethesda, MD). Cancer, Suppl.; 34: No. 4, 1510-1515(Jun 1974).

From national conference on virology and immunology in human cancer; New York, NY (29 Nov 1973).

Using a double antibody radioimmunoassay test, α-fetoprotein was elevated (i.e., over 40 ng/ml) in 72% of patients with hepatocellular carcinoma, 75% of patients with teratocarcinoma or embryonal cell carcinoma of the testis, 23% of patients with pancreatic carcinoma, 18% of patients with gastric carcinoma, 5% of patients with colonic carcinoma, and 7% of patients with bronchogenic carcinoma studied. In contrast to these positive findings in patients with cancer, none of the 210 normal controls over 1 year of age and only 1 of the 300 patients with chronic nonhepatic diseases other than ataxia telangiectasia had elevated levels. All of the 40 patients studied with the immunodeficiency disease, ataxia telangiectasia, had elevated AFP levels in accord with the view that these patients have a defect in organ differentiation. The radioimmunoassay for AFP was of special value in monitoring the effectiveness of therapy of certain forms of malignancy (e.g., hepatocellular carcinoma, embryonal cell carcinoma, and teratocarcinoma of the testis), since the product of a few tumor cells was detectable with this assay when AFP was undetectable as assessed by agar diffusion tests and when the residual tumor could not be detected by other clinical parameters. (auth)

930 RADIOIMMUNE ASSAY FOR THE DIAGNOSIS OF HUMAN CANCER. Egan, M. L.; Coligan, J. E.; Todd, C W. (City of Hope National Medical Center, Duarte, CA). Cancer, Suppl.; 34: No. 4, 1504-1509(Jun 1974).

From national conference on virology and immunology in human cancer; New York, NY (29 Nov 1973).

Radioimmune assay techniques based on tumor-associated antigens are finding application in the diagnosis of human cancer. There are two basic forms of radioimmune assay. One is based on complete saturation of the antibodies with antigen, and the other is based on a progressive filling of the antibody binding sites. The specificity and sensitivity of any assay depend primarily on the antiserum used. For high sensitivity a high binding constant for the antibody is important. The preparation of a suitable antiserum is described. Specificity in a radioimmune assay is never absolute, but may be improved through knowledge of the structure of the antigen. These principles are illustrated with the carcinoembryonic antigen. (auth)

931 PLASMA DISAPPEARANCE OF INJECTED SYNTHETIC LRH IN MAN AS MEASURED BY BIOASSAY AND RADIOIMMUNOASSAY. Virkkunen, P.; Lybeck, H.; Partanen, J.; Ranta, T.; Leppaeluoto, J.; Seppala, M. (Univ. Helsinki). J. Clin. Endocrinol. Metab.; 39: No. 4, 702-705(Oct 1974).

Synthetic LRH was injected iv as one pulse (100-200 μg) to 6 healthy men. Plasma and urine LRH were bioassayed (increase of plasma radioimmunoassayable LH in the rat); plasma LRH and LH were measured by radioimmunoassay (RIA). Plasma LH rose maximally from 28 ± 3 to 345 ± 90 ng/ml (mean ± SE, LER-907) after injection. The disappearance of LRH from plasma was rapid, $t_{\frac{1}{2}}$ = 2.9 min when measured by bioassay and $t_{\frac{1}{2}}$ = 2.7 min when measured by RIA within the first 5 min. Plasma LRH was not detectable after 20 min by bioassay, and varied from 0.8 to 4 ng/ml at 60 min when measured by RIA. LRH measured by RIA or by bioassay generally gave comparable results. Urine LRH was detectable by bioassay at 20 and 60 min only (1.5-2.4 ng/ml). When synthetic LRH was incubated in human plasma at 37°C for 90 min, no bioassayable loss of activity was found. LRH also was incubated in human plasma and submitted to gel filtration (Sephadex G-200) and LRH activity was found to be eluted after the major proteins, indicating that exogenous LRH is not evidently bound to major plasma proteins. (auth)

932 AUTORADIOGRAPHIC EXAMINATION OF IODINE BINDING IN FUNCTIONING (WARM) THYROID NODULES BY EX VIVO ^{125}I-PERFUSION OF SURGICAL SPECIMENS. Englund, N. E.; Nilsson, G.; von Mecklenburg, C.; Tibblin, S. (Univ. of Lund, Sweden). J. Clin. Endocrinol. Metab.; 39: No. 4, 673-683 (Oct 1974).

The microanatomy of the iodination process was studied autoradiographically in histological sections for light and electron microscopy as well as in fine needle aspirates from six surgically excised functioning ("warm") nodules perfused ex vivo with a tracer dose of ^{125}I for 15 min. In histological sections studied with light microscopy the strongest autoradiographic labeling was confined to small follicles, often in clusters of 5-20, situated among large, weakly labeled follicles. Electron microscopy autoradiography revealed that the label was confined to the follicular lumen, a finding in agreement with observations in similar studies in animals. No autoradiographic reaction was found over the follicular epithelium with the exception of so-called intracellular lumina, which were often massively labeled. In fine needle aspirates the autoradiographic label was confined to microfollicles and to small foci found within the multicellular follicle fragment obtained with this technique. (auth)

933 RADIOIMMUNOASSAY OF UNCONJUGATED ESTRADIOL IN URINE. Kono, S.; Lynn Loriaux, D.; Lipsett, M. B. (National Inst. of Health, Bethesda, MD). Acta Endocrinol.; 76: 741-746(1974).

A radioimmunoassay has been developed for the measurement of unconjugated estradiol in urine. After extracting with ether and purifying by thin layer chromatography, the assay is performed using anti-serum prepared against estrone-17-oxime-

bovine serum albumin conjugate. Dextran-coated charcoal is used to separate free and bound fractions. The measurable range on the standard curve is from 10 to 1000 pg. The blank of the method is 9.7 ± 3.6 pg (SD) and is independent of urine volume. The intra-assay coefficient of variation is 9.5% and the inter-assay variation is 12.8%. The accuracy and specificity of the method are also satisfactory. During one menstrual cycle, urinary free estradiol averaged 32 ng/day (n = 9, range 22 to 58) during the follicular phase; 341 ng/day at the mid-cycle peak; and 46 ng/day (n = 10, range 12 to 138) during the luteal phase. The estradiol content of 3 consecutive 24-h urines from a normal man was 4.8 ng/day (2.7 to 7.2). (auth)

934 SCANNING OF THE ADRENAL GLANDS. Yamada, H.; Ito, M. (Tokyo Metropolitan Geriatric Medical Center). Ketsueki To Myakkan; 5: No. 1, 51-54(Jan 1974). (In Japanese).

Iodine-131-labeled 19-Iodocholesterol is the only radiopharmaceutical that can outline the adrenal glands at present. Although it presents very useful clinical informations safely, it must be noted that the exposure dose, particularly the gonad dose, is very large. The application of the scanning must be, therefore, determined carefully. Especially in children and women, it is necessary to determine the indication strictly. The scanning should not be performed only because it is safe and easy, but it should be first performed after the complete endocrine test. (JA)

935 UPTAKE OF ^{57}Co-METHYLCOBALAMIN IN THE NERVE TISSUES AND THE INNERVATED MUSCLES IN RATS WITH CRUSH OF THE HEMISCIATIC NERVES. Kinoshita, K.; Yanagi, K.; Fujita, T.; Yamazu, K. (Eisai Co. Ltd., Tokyo). Igaku No Ayumi; 88: No. 12, 513-514(Mar 1974). (In Japanese).

Intraperitoneal administration of 5, 50, and 500 μg/kg/day of ^{57}Co-methylcobalamin was continuously done in rats with crush of the hemisciatic nerves. The uptake of radioactivity into the sciatic nerves and the gastrocnemius muscles in the degenerative side was compared with that in the normal side. The uptake of radioactivity into the nervous tissues increased with time and with doses. In addition, the uptake showed a high value ($P < 0.01$) with significance in the degenerative side after 8 days of crush corresponded to the primary stage of the reoccurrence of the axon-style followed by the regressive degeneration after crush of the sciatic nerves, compared with that of normal side. In addition, it showed a high value ($P < 0.01$) with significance in the degenerative side of the gastrocnemius after 8 days of crush. However, the amount of radioactivity in the whole gastrocnemius of the degenerative side was equal to that of the normal side. From these results, the fact that much more methylcobalamin was accumulated in the degenerative nerves than in the normal nerves suggested the possibility that methylcobalamin might contribute to the reoccurrence process of the nervous degeneration. (JA)

936 RETICULOENDOTHELIAL FUNCTION UNDER GENERAL ANAESTHESIA. Loefstroem, B. (Foersvarets Forskningsanstalt, Stockholm); Schildt, B. Acta Anaesth. Scand.; 18: 34-40 (1974).

The effect of five common anesthetics on the reticuloendothelial (RE) function was evaluated in 15 patients subjected to minor surgical operations. ^{125}I-labelled microaggregated human serum albumin was used as a RE test substance. All anesthetic techniques (cyclopropane, ether, halothane, neurolept analgesia, and epidural) caused a significant impairment of the RE phagocytic function when studied 1 h after the induction. The RE catabolic function was also decreased compared to a control group of volunteers. Possible mechanisms are discussed. (auth)

937 CELL MEDIATED LYMPHOLYSIS IN MAN. The Impact of SD Determinants on In Vitro Induced Lympholysis. Grunnet, N.; Kristensen, T.; Joergensen, F.; Kissmeyer-Nielsen, F. (Aarhus Univ., Denmark). Trans. Amer. Nucl. Soc.; 4: 218-228(1974).

Using the principles of Lightbody et al. (1971) the influence of SD differences in Cell Mediated Lympholysis (CML) between unrelated individuals was studied. These experiments showed that effector-lymphocytes sensitized against a number of SD determinants showed declining killing efficiency confronted with targets having four, three, two, or one of these determinants. Normally maximum killing efficiency was observed using stimulator and target lymphocytes from the same individual, while stimulator and target lymphocytes being unrelated but SD identical showed high, but not maximum killing. In SD identical effector/target combinations killing was not seen at a degree comparable to SD unidentical combinations. It was concluded that antigens shared by stimulator and responder/effector lymphocytes cannot be sensitized for in the Mixed Lymphocyte Culture. (auth)

938 STIMULATION OF HUMAN LYMPHOCYTES BY ALLOGENEIC ENDOTHELIAL CELLS IN VITRO. Hirschberg, H.; Evensen, S. A.; Henriksen, T.; Thorsby, E. (Rikshospitalet, Oslo). Tissue Antigens; 4: 257-261(1974).

Endothelial cells separated from the vein of human umbilical cords were capable of stimulating allogeneic lymphocytes in mixed lymphocyte endothelial cultures. The degree of stimulation observed with endothelial cells was generally less than that for mitomycin treated lymphocytes, but of the same order of magnitude. Endothelial cells proved non-stimulatory to autologous lymphocytes separated from cord blood. (auth)

939 DNA-SYNTHESIZING MYELOID AND LYMPHOID CELLS IN THE BLOOD OF HAEMODIALYSIS PATIENTS AND KIDNEY GRAFT RECIPIENTS. Virolainen, M.; Lalla, M.; Pasternack, A.; Wasastjerna, C.; Haeyry, P. (Gettysburg Coll., PA). Scand. J. Haematol.; 12: 391-400(1974).

The proportions of proliferating white blood cells in the blood of uraemic patients with and without hemodialysis treatment and in chronic kidney graft recipients were determined by 3H-TdR labelling and autoradiography. Labelled cells were differentiated into lymphoid cells (LLC) and myeloid cells (LMC). The reliability of the differential counts of LLC and LMC was verified by cytochemical staining methods combined with autoradiography. The percentage of LLC did not differ from that of the controls in any group of patients. In graft recipients the percentage of LLC was not associated with signs of chronic rejection. LMC were significantly increased in hemodialysis patients and in graft recipients. Anephric patients undergoing hemodialysis treatment had significantly more LMC than those who had retained their kidneys. Graft recipients presenting signs of chronic rejection and those receiving a higher corticosteroid dosage had more LMC than those without rejection. (auth)

940 RIBOFLAVIN AND THE METABOLISM OF ^{35}S-METHIONINE IN THE ORGANISM OF CHICKENS. Ermenkov, K.; Stanchev, Kh. Nauch. Tr., Vissh Selskostop. Inst., Plovdiv; 22: 369-376(1971). (In Bulgarian).

Experiments were carried out with 120 female chickens of the White Plymouth Rock breed to study the effect of adding various amounts of riboflavin to their food (4.40 and 80 mg/kg) on the exchange of ^{35}S-methionine in the molecule of glutathione, the albumen and acid-soluble fractions in some organs. The addition of an optimal dose of riboflavin (4 mg/kg) to the food of chickens was instrumental in the maximal incorporation and exchange of ^{35}S-methionine in the albumen of the analyzed viscera. Higher rates of riboflavin (40 and 80 mg/kg) did not cause any appreciable increase in the incorporation of radioactive-methionine in the albumen fraction of the organs. In this case the incorporation of radioactive-methionine into the molecule of the glutathione in the pancreas, muscles and kidneys is larger. (auth)

941 DETECTION OF AIRWAY CLOSURE WITH THE AID OF A MODIFIED ^{133}Xe-BOLUS TECHNIQUE. Konietzko, N.; Schiehe, K. H.; Gerke, E.; Adam, W.; Matthys, H. (Univ., Ulm, Ger.). Pneumonologie; 149: 113-117(26 Nov 1973). (In German).

A modified bolus technique for the measurement of closing volume is described; it involves the use of ^{133}Xe as tracer, a pneumotachograph in an open system for control of flow and volume, and a gamma camera for direct registration of the radioactivity over the lung. The results obtained in a group of 11 normal subjects are in good agreement with the predicted values obtained with the original ^{133}Xe bolus technique. The disadvantages of the method described are the expensive apparatus and the rather large amounts of radioactivity needed. The advantages are: easy handling of the open system, no dead-space effect compared to methods in which the tracer gas is recorded at the mouth, and regional location of airway closure. (auth)

942 DETERMINATION OF REGIONAL CEREBRAL BLOOD FLOW BY THE METHOD OF INTRAVENOUS INTRODUCTION OF ^{133}Xe. Kadashev, B. A.; Rodionov, E. N. Med. Radiol.; 19: No. 10, 9-13(Oct 1974). (In Russian).

A method for determination of the regional cerebral blood flow by intravenous introduction of ^{133}Xe is described. The specific methods for carrying out studies connected with the transmission of high activities through the lungs and with the introduction of isotopes into the arterial system are described. The use of special pumps for the extraction of the activity introduced and the necessity for supplementary shielding for the detectors are discussed. A new split ten-minute method for processing the clearance curves is proposed. This method makes it possible to subtract the contribution of extra-cerebral contamination from the sum curves and offers the possibility of determining the average cerebral blood flow through the object examined after 10 minutes. The average cerebral blood flow of man was

determined. It was 49.8 ± 3 ml/100 g/min. Three types of curves for the isotope introduction were obtained: one for the normal subject, one in the case of reduced blood flow, and one during shunting. The principal advantages of the determination of cerebral blood flow by intravenous injection of ^{133}Xe are summarized. (tr-auth)

943 RADIOISOTOPE LYMPHOGRAPHY IN MALIGNANT TUMORS OF THE TESTIS. Karparov, M. (Radioisotope Center and Radiological Clinic, Plovdiv, Bulgaria). Med. Radiol.; 19: No. 10, 28-32(Oct 1974). (In Russian).

A method was proposed for the scanographic study of lymph nodes in malignant tumors of the testis by the injection of colloidal ^{198}Au solutions on the day before the scanning. The first clinical tests of this method, carried out on 10 patients, were reported. The results showed the reliability of the method. (JSR)

944 PREPARATION OF TECHNETIUM-99m-LABELLED TOLUIDINE BLUE AND ITS DISTRIBUTION IN EXPERIMENTAL ANIMALS. Nakayama, T. (Kanazawa Univ., Japan). Kanazawa Irigaku Sosho; 95: 19-31(Mar 1974).

Toluidine blue was investigated as a potential pancreatotrophic agent by labelling with ^{99m}Tc and study of tissue distribution and localization following not only intravenous administration but more significantly after intraperitoneal instillation. Distribution of ^{99m}Tc-toluidine blue in rats showed pancreas to liver activity concentration ratios greater than 50 : 1 one hour following intraperitoneal administration with pancreatic localization of over one percent of injected dose. The corresponding pancreas to liver concentration ratio ten minutes after iv injection was only 3 : 1 with pancreatic localization of ^{99m}Tc-toluidine blue greater than 0.3% of injected dose. Scintiscans of experimental animals following intraperitoneal instillation of ^{99m}Tc-toluidine blue revealed pancreatic images at one to two hours post-administration. Because of rapid renal excretion of the compound, successful scans were not feasible when injected intravenously. Autoradiograms of pancreatic tissue following intraperitoneal injection confirmed parenchymal localization of ^{99m}Tc-toluidine blue high concentration. (auth)

945 ^{67}Ga SCINTIGRAPHY OF THE BRAIN—A SECOND CHOICE. Edeling, C. J.; Henriksen, O.; Fogh, J. (Rigshospitalet, Copenhagen (Denmark). Nuclear-Medicinsk Afdeling). Nucl.-Med.; 13: No. 2, 144-150(Aug 1974).

2 figs.; 2 tabs.; 7 refs.

Brain scintigraphy with ^{99m}Tc pertechnetate and subsequently with ^{67}Ga citrate was carried out in 55 selected patients. Among 29 patients with normal ^{99m}Tc scintigrams, eleven suffered from intracranial tumors and in five of these, visualization of the tumor was obtained by means of ^{67}Ga scintigraphy. Of 20 patients who showed abnormal ^{99m}Tc scintigrams as well as abnormal ^{67}Ga scintigrams, eighteen suffered from intracranial tumors and two from infectious lesions of the brain. The remaining six patients who had abnormal ^{99m}Tc scintigrams but normal ^{67}Ga scintigrams all suffered from vascular insults of the brain. It is concluded that ^{67}Ga citrate often accumulates in tumors which are missed by ^{99m}Tc scintigraphy, and that ^{67}Ga is not accumulated in areas of vascular insults of the brain as is ^{99m}Tc. (auth)

946 COMPARATIVE QUANTITATIVE SCINTIGRAPHIC STUDIES WITH ^{99m}Tc-PYROPHOSPHATE AND ^{85}Sr ON PATHOLOGICAL BONE LESIONS. Schmitt, G.; Stroetges, M. W.; Reinecke, V. (Essen Univ. (Gesamthochschule) (F. R. Germany). Radiologisches Zentrum). Nucl.-Med.; 13: No. 2, 104-112(Aug 1974). (In German).

5 figs.; 2 tabs.; 13 refs.

A quantitative comparison of ^{99m}Tc pyrophosphate and ^{85}Sr scintigrams of the skeleton of 22 patients with metastatic bone lesions was performed. Areas of increased local activity were counted. In addition, densitometric curves were obtained by translating dot scans into photo scans. In areas of increased activity the slope of the increase, the maximum and the background were calculated. In ^{99m}Tc scans 97 areas of increased activity were counted compared with 58 areas in ^{85}Sr scans. The parameters obtained with the densitometric curves were higher in scans with ^{99m}Tc than in scans with ^{85}Sr. (auth)

947 HETEROGENEITY OF PEPTIDE HORMONES. Its Implications for Radioimmunoassay. Yalow, R. S. (Veterans Administration Hospital, Bronx, NY). pp 3-22 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol. 1); CONF-7309119-(P1).

Evidence is presented that many peptide hormones are synthesized in a larger precursor form or forms that may be found in the circulation. Metabolic fragments of the usual biologically active form of the hormone may also be detected in the circulation with some antisera. Where precursor or fragment molecules represent a significant fraction of immunoreactivity the interpretation of radioimmunoassay results is not simple. However, when necessary, appropriate choice of the antiserum uses or fractionation of unknown solutions reduces the pitfalls associated with too facile acceptance of radioimmunoassay data. (auth)

948 SOME PROBLEMS OF SPECIFIC ANTIBODY PRODUCTION IN RADIOIMMUNOASSAY TECHNIQUES. Meretey, K.; Kocsar, L. T. (National Research Inst. for Radiobiology and Radiohygiene, Budapest). pp 23-29 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350(Vol. 1); CONF-7309119-(P1).

A common problem in setting up radioimmunoassay techniques is to induce the production of suitable specific antibodies in experimental animals. Rabbits and guinea pigs were chosen to prove the effectiveness of different immunizing procedures. TSH, T_3-BSA complex, prostaglandin-bovine γ-globulin, and pregnancy-associated α-globulins were used as antigens. Complete Freund's adjuvant and pertussis vaccine served as adjuvants. The antigens were administered into the foot pads or intracutaneously. Blood samples were collected at different intervals after antigen injection. The quality of the immune sera was controlled by binding labelled antigens to the antibodies. In agar-electrophoretic preparations, the radioactivity bound to the γ-globulin fraction was measured. The method of electrosyneresis was found also suitable to prove and measure the antibody content of the immune sera. The intracutaneous injection of small amounts of antigens or protein-bound haptens and the simultaneously i.v. administration of milliards of pertussis bacteria proved to be the most promising procedure. To control the complexing of prostaglandin to bovine γ-globulin, thin-layer chromatography was adopted. Under our laboratory conditions agar-electrophoresis and electrosyneresis seemed to be conveniently simple and rapid methods for selecting the most appropriate of the immune sera produced. (auth)

949 COMPARATIVE ASSESSMENT OF IMMUNIZATION PROCEDURES FOR RADIOIMMUNOASSAY. Lader, S.; Hurn, B. A. L.; Court, G. (Wellcome Research Labs., Beckenham, Eng.). pp 31-44 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol. 1); CONF-7309119-(P1).

Two series of experiments have been undertaken with the aim of comparing various immunization techniques. In one series, the method of multiple intradermal injection (after Vaitukaitis et al.) was performed in parallel with a standard schedule using sequential intramuscular injections. Four different immunogens were used (T4-BSA, Oestradiol-BSA, angiotensin I, and h-TSH) in rabbits; in all instances, primary injections contained 100 μg and boosters contained 50 μg of immunogen in Freund's emulsion; booster injections in both schedules were given intramuscularly. Individual sera bled at intervals throughout the immunization were tested for titre and avidity. Except in the case of angiotensin I (where only three animals responded, all in the intradermal group) both schedules gave comparable responses; mean titres were slightly higher in the intradermal series, but avidity (as measured by sensitivity in an assay system) was almost identical for the two groups. After the intradermal injections, titres rose steadily to their maximum in about 10 weeks and no further change occurred on boosting; these findings confirm the claims made for the economy in time and materials of this technique by comparison with the standard procedure. Another series of experiments was intended to amplify preliminary results, reported previously, concerning the beneficial effect of a prolonged rest during immunization. Six groups of ten guinea pigs each were immunized with porcine insulin in Freund's emulsion. The control group received a standard regime of 0.5 mg immunogen monthly for six injections; other groups received variations in dosage or in timing, with a rest of four months either near the beginning or near the end of the injection schedule. All injections were made subcutaneously at a single site. Individual bleeds were tested for titre and avidity. With one exception, all groups yielded comparable results in terms of both titre and avidity, so the earlier results were not confirmed. The one group that gave outstandingly poorer results than the rest

had received rapidly increasing doses of immunogen in emulsion at frequent (weekly) intervals. The study highlights the difficulties of making valid comparisons between different immunization procedures, especially in a field where one exceptional antiserum is worth more than any number of second-rate ones. (auth)

950 PROBLEMS OF OPTIMIZATION OF DOUBLE ANTIBODY RADIOIMMUNOASSAY OF HLH, HFSH, AND HGH. "Hook" Phenomenon, False Negative Patient Values, and Linearity of Values from Patient Plasma Dilutions. Joel, E. W.; Schoenberg, D. K.; Ilg, W.; Keller, E. pp 45-58 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol. 1); CONF-7309119-(P1).

To measure the physiological and pathological levels of HLH, HFSH, and HGH in plasma of prepubertal, dwarfed children and amenorrhoeic women it is essential to have a reliable and precise radioimmunoassay with a high sensitivity. For the assay of gonadotropins the standard used was LER-907, and for iodination LER-960 and LER-1366 were used which, together with the antiserum, were obtained from NIAMD-NIH, Bethesda. The measurement of HGH was set up using the standard preparation from MRC, London, which was also used for iodination. The antiserum for this assay was obtained from Sylvana, New Jersey. Both systems were tested for the following: (1) the "hook" phenomenon, i.e. the elevation of the first part of the standard curve; (2) nonspecific increase of bound labelled hormone by the sera of certain patients and of animals; (3) linearity of data obtained by dilution of patient plasma levels in ranges from 20 μl to 200 μl. The first phenomenon depends on the suitable dilution of individual specific first antisera and is completely overcome at final dilutions starting with 1:20,000 for the anti-HFSH (NIH) and 1:30,000 for anti-HLH (NIH). The second phenomenon and between-assay reliability depend on the volume of plasma, the careful selection of dilutions of the second antiserum, and on the amount of species-specific antiserum used for the enlargement of the precipitate as well as on the titre of the first antibody. In some cases, the addition of the most interfering humans or animal plasma did not influence this side effect. Linearity over a wide range of hormone concentrations and plasma dilutions posed the greatest difficulty. It was neither achieved by adding plasma of hypophysectomized patients to the tubes for the standard curve nor by raising the concentration of the second antibody. It could only be achieved by adjusting the dilution of the final antiserum. Nevertheless, the assay system as optimized so far enables one to measure with good reproducibility fluctuations of pituitary hormone levels in plasma in the clinical situations described. (auth)

951 PREPARATION OF HUMAN PROTEIN HORMONES FOR USE IN RADIOLIGAND ASSAYS. Structure–Function Considerations. Reichert, L. E. Jr. (Emory Univ., Atlanta). pp 59-69 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol. 1); CONF-7309119-(P1).

The United States National Institute of Arthritis, Metabolism, and Digestive Diseases (NIAMDD) through the National Pituitary Agency, sponsors a program for collection of useful quantities of human pituitary glands as the source of protein hormones used in clinical research and in development of radioligand assays for their measurement. The anterior pituitary hormones are isolated by standard procedures of protein chemistry, including salt fractionation, ion-exchange chromatography, and gel filtration. These methods are reviewed briefly. An understanding of the structural features of the protein being measured is essential, since requirements for immunological activity, in-vitro receptor-binding activity, and in-vivo biological activity are often quite distinct. It is necessary to appreciate the significance of such differences if serious errors in interpretation of analytical results are to be avoided. Problems encountered in the development of competitive protein-binding assays for the human pituitary glycoprotein hormones are typical of those likely to be encountered with other proteins of research or clinical interest. They have therefore been chosen as model substances, about which suggestions are made for possible improvement of assay specificity and for a discussion of certain caveats arising in their measurements. A summary list of pituitary materials distributed gratis by the NIAMDD hormone distribution program to qualified investigators world-wide (supplies permitting) is included. (auth)

952 STANDARDS FOR REFERENCE REAGENTS FOR RADIOIMMUNOASSAY OF PEPTIDE HORMONES AND RELATED SUBSTANCES. Cotes, P. M. (National Inst. for Biological Standards and Control, London). pp 71-87 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol. 1); CONF-7309119-(P1).

Principles involved in the provision and use of standards for radioimmunoassay of peptide hormones are discussed in detail. Data relating to some of the preparations presently distributed by and available on request from the Division of Biological Standards are summarized and discussed. (auth)

953 AUTOMATION OF RADIOIMMUNOASSAY AND OTHER SATURATION ASSAY PROCEDURES. Ekins, R. P. (Middlesex Hospital, London). pp 91-109 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol. 1); CONF-7309119-(P1).

Automation is a term derived from the language of cybernetics implying concepts of feed-back control and regulation. An automated assay system therefore constitutes more than an automatic pipetting machine; it must include elements related to assay design, and to the processing of crude assay data in a manner both to yield final statistically evaluated results, and to give guidance on the setting up of future assays. The paper briefly reviews current developments in these three aspects of assay automation: i.e. in assay design, assay instrumentation, and the analysis of assay results. (auth)

954 CALCULATION OF THE RADIOIMMUNOASSAY STANDARD CURVE BY SPLINE FUNCTION. Marschner, I.; Erhardt, F.; Scriba, P. C. (Univ., Munich). pp 111-122 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol. 1); CONF-7309119-(P1).

A project was proposed to fully automate radioimmunoassay. Firstly a computer program was applied to the calculation of the standard curve without distortion of its sigma form. This mathematical process, called "smoothing by spline function", has been applied recently for technical and physical purposes, and calculates trial functions between points on the standard curve, whereby the curve segments on their common end points and their first and second differentials are steady and the total curve has minimal oscillation. The count-rates are fed off-line by paper-tape into a Siemens 404/3 computer. A plotter draws a semilogarithmic graph of the coordinates, sets the calculated standard curve and plots the standard deviation of the points. The smoothing parameter is selectable, and points which are in error can be corrected or eliminated for each case. After examination of the standard curve and eventual correction, the calculation of the hormone concentration of the unknowns is processed by the second part of the program. (auth)

955 RAPID ASSAY FOR LUTEINIZING HORMONE AND EVALUATION OF DATA BY NEW COMPUTER PROGRAM. Spona, J. (Univ., Vienna). pp 123-130 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol. 1); CONF-7309119-(P1).

A rapid radioimmunoassay is a prerequisite for evaluation of patients suffering from endocrine diseases. The method described is based on the fact that gamma-γ-globulins adhere to plastic surfaces. Coating of plastic tubes is achieved by incubating them with antiserum against HCG diluted in buffer at pH 9.6. After 2 hours at room temperature the mixture is aspirated and the tubes are washed with buffer. Then 1 ml of the different dilutions of the standard (LER-907) and the unknown sera are pipetted into the coated tubes and incubated for 2 hours at 37°C. Tracer (100,000 counts/min ^{125}I-LH per 0.5 ml) is added and the incubation extended for another 2 hours. The incubation mixture is aspirated and the radioactivity bound to the tubes is counted in an autogamma spectrometer. The data are evaluated by means of a PDP-8/e computer using a theoretical curve of counts/min against concentration instead of linearizing the radioimmunoassay curve. The equation $y = \exp\{\exp[2 + 1/100\ (ax^2 + bx + c)]\}$ was empirically obtained and found to describe the standard curves best. The sensitivity (0.25 to 0.5 mIU LH), coefficient of variation (7 to 12%), and short assay time (4 hours) of the procedure described lend themselves to its application for timing of ovulation in sterile patients. (auth)

956 NEW DEVELOPMENTS IN THE IMMUNORADIOMETRIC ASSAY. Addison, G. M. (University Hospital of Wales, Cardiff). pp 131-147 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol. 1); CONF-7309119-(P1).

Immunoradiometric assays have now been applied to the assay of a number of polypeptide hormones and other antigens. The various methods used for the production of immunoadsorbents and ^{125}I-labelled antibodies are described and the mathematical analysis of the immunoradiometric assay is discussed. The development of the "two site assay" using solid phase antibodies together with labelled antibodies is described and the advantages of this approach in increasing assay specificity is discussed. (auth)

957 PROPERTIES OF TWO-SITE IMMUNORADIOMETRIC (LABELLED ANTIBODY) ASSAY SYSTEMS. Miles, L. E. M. (Stanford Univ., CA); Bieber, C. P.; Eng, L. F.; Lipschitz, D. A. pp 149-164 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol. 1); CONF-7309119-(P1).

Two-site immunoradiometric assay systems ("two-site" IRMA) are carried out by (1) reaction of the soluble unknown antigen with a solid-phase antibody, (2) reaction of the insoluble product with a purified radioactively labelled antibody. Unreacted radioactive antibodies remain soluble and are washed away. As the dose of antigen increases, the radioactivity bound to the solid-phase increases. Properties of the "two-site" IRMA system have been studied using assays for human growth hormone, ferritin, and glial fibrillary acidic protein. Variables studied were (a) concentration and stability of solid-phase antibody, (b) variation in temperature, reaction volumes, reaction times, and reagent concentrations, (c) stability and storage of antibody coated tubes, (d) effect of tube washing cycles, (e) antigen or antibody reagent exchange (with time), (f) effect of sarcosyl, salts, serum proteins, dextrans, Tween-20, cerebrospinal fluid, and anticoagulants. Systems using specific antibodies raised in two animal species were examined. A variety of immunoglobulin "spacer" arms were prepared which connected the solid-phase antibody to the matrix. Some preparations substantially modified the "serum" effect which is otherwise a consistent feature of solid-phase assay systems. The use of ^{125}I-anti(IgG) as a general assay reagent was also demonstrated. Statistical analysis, dose interpolation, and automatic data processing were carried out by a generalization of the logit/log method and computer programs used in conventional radioimmunoassay. The properties of "two-site" immunoradiometric assay are closely related to the usual immunoradiometric assay system, but "two-site" immunoradiometric assay is more economical in antigen, cannot be subject to deleterious allosteric or "second site" reactions, and has a lower zero dose-response (0.5 to 2% of the total radioactivity in the system). It may also have advantages in reagent stability, effective assay range, specificity, versality, antigen protection, and suitability for automation. (auth)

958 STATISTICAL ANALYSIS OF RADIOIMMUNOASSAYS AND IMMUNORADIOMETRIC (LABELLED ANTIBODY) ASSAYS. A Generalized Weighted, Iterative, Least-Squares Method for Logistic Curve Fitting. Rodbard, D. (National Institutes of Health, Bethesda, MD); Hutt, D. M. pp 165-192 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol. 1); CONF-7309119-(P1).

The statistical aspects of immunoradiometric assays (IRMA), including the "2-site" IRMA or "sandwich" assay have been analyzed in detail. Although these assays are similar to radioimmunoassays (RIA) which employ labelled antigen, several new problems are encountered. The dose response curve, expressed in terms of counts or counts/min versus log(X) is sigmoidal in character. This curve may be described by a logistic function of the form $Y = (a - d)/\{1 + (X/c)^b\} + d$, where Y is the response in counts, X is dose, and a, b, c, d are four fitted parameters. A computer program has been developed for curve-fitting and dose interpolation using this equation and the Gauss-Newton algorithm for non-linear least-squares regression. In general, the IRMA and especially the "2-site" IRMA display severe non-uniformity of variance. The variance of the response variable is well described in the relationship $\sigma_Y^2 = a_0 + a_1 Y + a_2 Y^2$. This same relationship has been utilized previously for RIAs. Accordingly, it is mandatory to use a weighted regression. After each iteration, σ_Y is calculated as a function of $\hat{Y}$, where $\hat{Y}$ is the value predicted on the basis of the previous iteration for any given X value. Thus, weights $(1/\sigma_Y^2)$ are implicitly a function of X. In "2-site" IRMAs the term $a_2 Y^2$ predominates. Thus, the coefficient of variation of the response variable is nearly constant (at about 10%) and the weights assigned to each point on the dose response curve may be obtained by use of the "logit-log" method developed in this laboratory. The current computer programs are also applicable to RIAs in which either the bound or the free forms of tracer are counted, and to certain bioassays and enzymatic assays, permitting automated data processing. (auth)

959 RADIOIMMUNOASSAYS OF GLYCOPROTEIN HORMONES. Franchimont, P.; Hendrick, J. C.; Reuter, A. M.; Burger, H. G. (Univ., Liege). pp 195-211 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol. 1); CONF-7309119-(P1).

Radioimmunoassays of glycoprotein hormones were first suggested in 1965-66 and have provided a means for investigating their secretion under normal and pathological conditions. They have also provided an approach to the problem of the physiological significance of subunits. Nevertheless, these methods are still complicated and require a number of checks to be carried out by those applying them: checks on the purity of the labelled hormone, checks on the specificity of the antisera used, and checks on the method used to separate the free labelled hormone from the labelled hormone bound to the antibodies. Each of these analytical steps is described in the paper. (auth)

960 RADIOIMMUNOLOGICAL DETERMINATION OF THYROTROPHIC HORMONE IN THE HYPOPHYSIS AND BLOOD OF RATS: STUDY OF THE VARIATIONS IN CONCENTRATION AFTER DIFFERENT TREATMENTS. Simionescu, L.; Sahleanu, V.; Oprescu, M.; Orbesteanu, V. (Inst. of Endocrinology, Bucharest). pp 213-219 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974). (In French).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol. 1); CONF-7309119-(P1).

From a series of experiments conducted between 1950 and 1965 the authors had drawn preliminary conclusions with regard to the dynamic behavior of TSH (thyroid-stimulating hormone) under various conditions of stress or adaptation and under the influence of medication affecting the central nervous system; the biological method, however, permitted only a semi-quantitative determination of the hypophyseal TSH level. Furthermore, the criteria applied in evaluating hypophyseal activity were indirect. Following the development of radioimmunological methods for measuring TSH in blood, the authors resumed their studies and carried out radioimmunological determinations with double antibodies, using rat TSH and rat anti-TSH serum. The sensitivity of the method was 2.0 μU/tube (9.0 ng/tube). The concentrations in the serum of normal male rats, following exsanguination, were found to be comparable with those obtained by other authors. The variations in the hypophyseal and serum TSH levels observed after various forms of treatment (medication, forced immobilization, exposure to cold) applied singly or in combination are listed in a table. The results are illustrated by curves and explanations are given. (auth)

961 RADIOIMMUNOASSAY OF HUMAN THYROTROPIN: MATERNOFOETAL RELATION AT HIGH ALTITUDE. Paredes-Suarez, M.; Varea Teran, J. (Hospital Carlos Andrade Marin, Quito, Ecuador). pp 221-235 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974). (In Spanish).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol. 1); CONF-7309119-(P1).

The authors have studied the changes in the HTSH levels in adult men and women from coastal areas (at sea level) who have been subjected to acute exposure to a high altitude (Cerro de Pasco, 4300 m above sea level). Studies have also been carried out on similar groups of people from Cerro de Pasco who have been transferred to a sea-level area. They have also investigated the relationship between maternal and foetal TSH in adult women from Cerro de Pasco during the final stage of pregnancy and at the time of parturition. The findings were then compared and the possible implications analyzed. (auth)

962 IMMUNOLOGICAL CROSS-REACTIONS OF LH AND HCG. Contributions of the Subunits and of the Conformation of the Native Hormone. Jacobs, H. S.; Vanthuyne, C.; Ekins, R. P. (Middlesex Hospital, London). pp 237-243 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol. 1); CONF-7309119-(P1).

Most radioimmunoassays (RIA) for luteinizing hormone (LH) utilize its cross-reaction with antisera prepared against human chorionic gonadotrophin (HCG). The authors have studied the contributions to this cross-reaction of the α- and β-subunits of LH and HCG and of the native hormones. The results obtained with an anti-HCG serum have been compared to those obtained with antisera prepared against the β-subunits of both hormones. By using the antisera raised against both the β-subunits of HCG and of LH, the homologous subunit inhibited binding with greater potency than the native hormone or the α-subunits, irrespective of whether the β-subunit or the native hormone was used as the label. In contrast, using the anti-HCG serum, native LH and HCG inhibited binding with greater potency than any of the subunits, again irrespective of which antigen was used as label. In addition, both in the ^{125}I-LH and the ^{125}I-HCG anti-HCG systems, β-subunits of LH and HCG inhibited binding with greater potency than did α-subunits of LH and HCG. Finally, the α-subunit of LH appeared to be more potent than the α-subunit of HCG, perhaps because of greater contamination with the β-subunit. We conclude that the cross-reactivity of LH with HCG, which forms the basis of most radioimmunoassays for LH, cannot be explained on the basis of shared α-subunits. Indeed, greater similarity (that is, an approach towards equipotency) was seen with the β-subunits than with the α-subunits. The cross-reactions of LH and HCG therefore depend upon confirmational features of the hormone rather than of the subunits. (auth)

963 IMMUNOLOGICAL IDENTITY OF ANTIBODIES AGAINST URINARY AND PITUITARY FOLLICLE-STIMULATING HORMONE. Olivieri, V.; Ricci, G.; Donini, P. (Instituto Farmacologico Serono, Rome). pp 245-251 of Radioimmunoassay and Related Procedures in Medicine. Vol. 1. Vienna; International Atomic Energy Agency (Mar 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol. 1); CONF-7309119-(P1).

Follicle-stimulating hormone (FSH) extracted from postmenopausal urine has been used to immunize rabbits and to obtain antibodies. Antisera so obtained were studied by several authors in order to check the cross-reaction between FSH of pituitary and urinary origin. This cross-reaction has been claimed up to now to be incomplete, leading to the conclusion that an immunological difference does exist between both forms of the hormone, as a difference exists in the amino acid composition. The paper demonstrates that this conclusion is not correct and that the misleading results of previous findings are due to the use of non-specific antisera. The authors studied the immunological behavior of many anti-urinary FSH, before and after absorption, by using iodinated urinary and pituitary FSH as a tracer. The results can be summarized as follows: all antisera against urinary FSH contain, in various ratios, two populations of antibodies of which one is specifically directed only against FSH, and the second cross-reacts with urinary FSH and other urinary proteins. This second group of antibodies cannot be eliminated by absorption with hCG alone, but is precipitated by incubation of the antiserum with urinary gonadotrophin-free extract. The anti-urinary FSH serum so absorbed shows a complete cross-reaction between urinary and pituitary FSH, i.e. it binds both forms of the iodinated hormone, and gives with both tracers superimposable inhibition curves with cold urinary and pituitary FSH. The non-specific antibody population present in the untreated antiserum does not react with pituitary FSH, so it does not interfere in the assay when using iodinated pituitary FSH. From these findings it can be assumed that urinary FSH as an antigen possesses two different antigenic determinants of which one is shared with pituitary FSH and the second is common to other urinary proteins. (auth)

964 COMPARISON OF DIFFERENT METHODS FOR RADIOIMMUNOLOGICAL DETERMINATION OF GONADOTROPHINS. Reuter, A. M. (Institut National des Radioelements, Fleurus, Belgium); Hendrick, J. C.; Becker, H.; Franchimont, P. pp 253-265 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974). (In French).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol. 1); CONF-7309119-(P1).

Three methods of separating the antigen-antibody complex and free antigen were compared by means of radioimmunological systems determining FSH (follicle-stimulating hormone), LH (luteinizing hormone), and HCG (human chorionic gonadotrophin); these involved antibody immunoadsorbent, conventional double antibody, and anti-γ-globulin immunoadsorbent, or DASP, techniques. Chemical fixation of the antihormone antibody on a solid matrix (microcrystalline cellulose) is an elegant and rapid method, but it is less sensitive and less accurate than the conventional double antibody technique. Furthermore, the effect of serum proteins is particularly marked in this method, and although it is possible to neutralize this effect, the operation adds a stage and represents a further source of measurement error. The conventional method of double antibody immunoprecipitation is very sensitive and interference by serum proteins is usually negligible, but it requires two successive operational stages. Furthermore, to obtain a precipitate that can easily be separated by centrifuging, it is necessary to add a fairly large quantity of normal γ-globulins and anti-γ-globulin antibody so as to fall within the range permitting macroscopic immunological precipitation. Fixation of anti-γ-globulin on a solid support combines the sensitivity and reproducibility of the double antibody immunoprecipitation system with the ease of handling characteristic of immunoadsorbents. The serum protein effect is negligible. The method does not need the addition of γ-globulins and the antigen-antibody complex can be separated in 6 hours. The gonadotrophins were measured in the same sera by the three separation methods, with two different antisera for each hormone. Correlations were established between the different results. (auth)

965 DIAGNOSTIC USE OF A RADIORECEPTOR ASSAY FOR HUMAN CHORIONIC GONADOTROPIN. Talas, M.; Midgley, A. R. Jr. (Univ. of Michigan, Ann Arbor). pp 267-273 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350(Vol. 1); CONF-7309119-(P1).

A simple and rapid ligand assay method for the determination of human chorionic gonadotropin (hCG) in serum has been developed. Membrane-rich pellets containing receptor for luteinizing hormone (LH/hCG) were used as the binding agent. The pellets were obtained by homogenization and low-speed centrifugation of luteinized ovaries from pseudopregnant rats induced by prior treatment with pregnant mare serum gonadotropin (PMS) and hCG. Highly purified hCG was labelled with ^{125}I using chloramine-T and separated by gel filtration on a column of Bio Gel P60. The binding of the ^{125}I-hCG to the receptor-rich pellets was inhibited by hCG, LH, and serum from pregnant women. In an effort to eliminate non-specific effects of serum, serum containing a low amount of LH was added to each test tube so that all tubes received a fixed total serum volume of 100 μl. Inhibition curves of sera of pregnant women were parallel to those of the 2nd International Reference Preparation of Human Menopausal Gonadotropin (2nd-IRP-HMG), the 2nd International Standard of HCG, a human pituitary reference preparation (LER-907), and a variety of other preparations containing human LH. Recovery of LH or hCG added to sera was quantitative. This method has been used to determine the concentration of hCG in sera from 116 women who had been pregnant for 7 to 40 weeks. The results were similar to, but slightly lower, than those found previously by radioimmunoassay. The latter discrepancy may reflect the presence of immunologically active, biologically inactive hCG in serum. (auth)

966 RADIOIMMUNOASSAY OF HUMAN ERYTHROPOIETIN. Garcia, J. F. (Univ. of California, Berkeley). pp 275-287 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 Vol. 1); CONF-7309119-(P1).

A radioimmunoassay for the glycoprotein hormone erythropoietin has been developed using a purified human urinary erythropoietin preparation and an anti-erythropoietin antiserum prepared in rabbits. The erythropoietin used for labelling with ^{125}I was freed from some contaminating protein by G-150 Sephadex gel filtration after first absorbing with an antiserum prepared against normal human urinary protein. The erythropoietin peak was then combined with an anti-erythropoietin antiserum and again placed on the Sephadex column. The labelled erythropoietin γ-globulin complex, thus separated, was dissociated by an acidification-heating procedure which freed the labelled erythropoietin.

With the double antibody technique, this labelled erythropoietin was then used in a radioimmunoassay of human plasma erythropoietin with the first international reference preparation as a standard. This radioimmunoassay for human erythropoietin is more sensitive than the standard bioassay for human erythropoietin by a factor of approximately 10. With this radioimmunoassay scheme, plasmas from normal individuals always give low values with an average for a series of males of 4.9 mU/ml and females of 4.3 mU/ml. Plasmas from anaemic individuals always give higher values, although usually not as high as the bioassay for erythropoietin would indicate. Support for the validation of the radioimmunoassay for human plasma erythropoietin was obtained by the parallel relationship with the standard of halving dilutions of a high erythropoietin plasma. Further, bleeding of a normal individual increases the radioimmunoassayable erythropoietin level and return of the blood decreases it. Although this response in plasma is below the detectability of the bioassay for erythropoietin, the bioassay of concentrates of urine maintained the same relative picture as that seen by the radioimmunoassay of the plasma. The radioimmunoassay appears to be specific for human erythropoietin, with no competition afforded by several animal erythropoietins. Although removal of the sialic acid completely destroys the biological activity, it does not interfere with the radioimmunoassay of human erythropoietin. Further details of this radioimmunoassay, as well as its application to the variety of clinical material, are discussed. (auth)

967 STANDARDIZATION OF RADIOIMMUNOASSAY TECHNIQUE FOR DETERMINATION OF PLASMA INSULIN AND GROWTH HORMONE. Zazuco Higa, O.; Torres de Toledo e Souza, I.; Wajchenberg, B. L.; Pinto, H.; Ribeiro Pieroni, R. (Inst. of Atomic Energy, Sao Paulo, Brazil). pp 291-307 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol. 1); CONF-7309119-(P1).

The assays were performed with porcine insulin-^{125}I and human growth hormone (HGH)-^{125}I after labelling by the technique of Hunter and Greenwood and purifying by starch gel electrophoresis (for separation of the over-iodionated fractions) followed by further purification in gel Sephadex columns, to discard damaged components and free iodine. The final labelled fraction was more than 90% free from damaged hormone with excellent immunoreactivity. The assays were carried out with guinea-pig antisera specific to porcine insulin and to HGH. The separation of free from antibody-bound hormone was done with charcoal. These methods were standardized by evaluating the following parameters: Accuracy. The accuracy was tested by the addition of progressively larger amounts of insulin (or plasma) to a known amount of plasma (or standard HGH). The recovery varied from 93 to 105% with a coefficient correlation r between the theoretical and found values of 0.997 for insulin and recoveries, varying from 70 to 103% for HGH, with a coefficient correlation r of 0.985. Specificity. Specificity was tested with progressively larger dilutions of a plasma sample, the correlation coefficient r with the apparent hormonal concentration being 0.998 for both insulin and HGH. Precision. Precision was evaluated through the reproducibility of a pool of plasma studied within-assay and between-assay. The coefficient of variation for insulin was 7.4% and 7.6% for within-assay and between-assay, respectively, and 4.6% and 6% for HGH under the same conditions. The range of the standard curves studied was from 0.01 to 1 ng for insulin and 0.02 to 2.0 ng for HGH. Sensitivity. Sensitivity was found to be 1.25 μU/ml and 1.5 ng/ml of plasma for insulin and GH, respectively. (auth)

968 RADIOIMMUNOLOGICAL BEHAVIOR OF ENDOGENOUS AND EXOGENOUS HUMAN GROWTH HORMONE. von Werder, K.; Desalm, C.; Gallenberger, S.; Gottsmann, M.; Scriba, P. C. (Univ., Munich). pp 309-321 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol. 1); CONF-7309119-(P1).

The immunoreactivity of endogenous human growth hormone (HGH) and of exogenous HGH after infusion into patients has been investigated. Four different HGH preparations gave identical standard curves documenting immunoidentity. Complete immunoidentity could not be demonstrated for "big" HGH which was separated from regular HGH by dextran gel filtration. The HGH immunoreactivity, which was eluted from the column ahead of "big" HGH, showed an even more pronounced change in immunoreactivity. Exogenous and endogenous human placental lactogen (HPL) showed the expected deviation from the HGH standard curve, whereas bovine prolactin (BPr) and high endogenous immunoassayable HPr (3200 ng/ml) did not cross-react with the HGH antibody. Immunoidentity of HGH with the standards was documented in 10 patients with acromegaly. This was true for samples from the jugular vein as well as from the periphery. Eight insulin tolerance tests (ITT) were performed in patients with normal HGH secretion. Samples at 30, 45, 60, and 90 min were diluted and the resulting slopes compared with the standard curve. Whereas the slopes of the 30-, 45-, and 60-min samples were parallel, the slopes of the 90-min samples deviated from the standard curve. Exogenous HGH was infused (2 mg for 30 min for each person) into five normal subjects (I) and five patients with HGH deficiency (II). HGH levels rose to 171.6 ± 19.8 ng/ml (I) and 192.4 ± 34.8 ng/ml (II). HGH half-time of disappearance was 14.9 ± 3.9 min (I) and 19.1 ± 6 min (II). There was no change of HGH immunoreactivity over a period of 2 hours. In summary: (1) Cross-reactivity of HPL but not of HPr with HGH antibodies was demonstrated. (2) HGH in acromegaly and exogenous HGH after infusion have identical immunoreactivity. (3) The change in endogenous HGH immunoreactivity 90 min after stimulation is apparently due to the secretion of a different HGH immunoreactivity that is most likely residing in a larger molecular weight fraction. (auth)

969 DEGRADATION OF LABELLED HORMONE IN RADIOIMMUNOASSAY OF ACTH. Virasoro, E.; Copinschi, G.; Bruno, O. D. (Univ. Libre, Brussels). pp 323-335 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol. 1); CONF-7309119-(P1).

Degradation of labelled hormone constitutes one of the major problems in the development of a radioimmunoassay for ACTH. Therefore the authors have investigated different factors susceptible to reduce the damage to the hormone during labelling and subsequent degradation during incubation. The following conclusions were reached: (a) the rapidity of the labelling procedure is critical. The whole procedure (including the addition of sodium metabisulphite to stop the reaction) must be performed within 6 sec. The following amounts of reagents were used: 0.8 – 1.0 mCi ^{125}I or 2.0 mCi ^{131}I; 2 μg ACTH; 50 μg chloramine-T; and 90 μg $Na_2S_2O_5$. (b) The quality of the radioactive iodine is primordial. Batches suitable for adequate labelling of other peptides may be inappropriate for ACTH. (c) The degree of the degradation and of the purification, as evidenced in the classical chromato-electrophoresis used to separate damaged and undamaged labelled hormone, is a poor indication of the radioimmunological behavior of the tracer. Moreover, a large amount of non-specific binding of damaged material to proteins does not exclude the use of a tracer for radioimmunoassay. The following preservatives were added to the incubation medium: mercaptoethanol, 0.4% and Trasylol, 500 kIU/ml. Under these conditions, no significant degradation can be evidenced during the first 4 days of incubation at 4°C; thereafter, degradation rapidly increases. (d) Degradation of the tracer is higher when incubation is performed in the presence of heparinized plasma than with EDTA-treated plasma. Therefore, blood should always be collected with EDTA. Labelled ACTH suffers greater degradation when incubated in plasma diluted 1:5 than at 1:10. As a result of these observations, we have developed a satisfactory radioimmunoassay for ACTH, which is described and analyzed. (auth)

970 RADIOIMMUNOLOGICAL DETERMINATION OF PLASMATIC PARATHYROID HORMONE IN MAN. Gueris, J. (Hospital F. Widal, Paris). pp 337-352 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974). (In French).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol. 1); CONF-7309119-P1).

The authors discuss a system for radioimmunological measurement of human plasmatic parathyroid hormone. It is based on a heterogeneous system made up of a bovine tracer, porcine antiparathyroid hormone antibody, and a human standard which may be either a hyperparathyroid plasma or a purified extract of the liquid from a parathyroid adenoma culture. The parallelism between the two standard curves obtained in this way makes it possible to confirm the identity of different standards at the immunoreactivity level. Purified bovine parathyroid hormone is iodinated by the chloramine-T method, the denatured fraction from the iodination being eliminated by passage through a cellulose microcolumn or through QUSO-32. The immunoreactivity of the tracer obtained with the two methods is compared. Adsorption of the parathyroid hormone on different supports (glass or plastic) is studied as a function of the protein concentration of different media. Incubation lasts five days at 4°C, and the tracer

is added later so as to obtain a non-equilibrium system. The free and bound fractions are separated by a modified version of the charcoal dextran method. The effect of the protein concentration of the incubation medium is evaluated. The validity of the results is estimated by comparing the values obtained with serial dilutions of the plasmas studied. The method thus makes it possible to detect parathyroid hormone in the majority of normal human plasmas. The parathyroid hormone level was studied in different types of hypercalcemia. A high level was found in all the primary hyperparathyroidisms confirmed by surgery. Similarly, the parathyroid hormone level undergoes a significant increase during chronic renal insufficiency. In paraneoplastic hypercalcemia high levels are found only sporadically. Parathyroid hormone is no longer detectable in patients who have undergone major thyroid surgery followed by radiotherapy. Although much remains to be learned about the nature and quality of the parathyroid hormone measured in the blood stream, a determination of this kind provides essential information in many areas of pathology—particularly in the surveillance of chronically hemodialysed patients. (auth)

971 RADIOIMMUNOASSAY FOR HUMAN SERUM PARATHYROID HORMONE. Methods and Clinical Evaluation. Bouillon, R.; Koninckx, P.; De Moor, P. (Catholic Univ., Louvain, Belgium). pp 353-365 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol. 1); CONF-7309119-(P1).

Sixteen different guinea-pig antisera against bovine parathyroid hormone were tested for possible use in a sensitive, cross-reacting human parathyroid hormone radioimmunoassay. Only two cross-reacting antisera permitted measurement of serum parathyroid hormone levels in most normal persons. For the purification of the labelled parathyroid hormone after initial QUSO extraction and elution, gel-filtration on Bio Gel P-60 or extraction with Sepharose-bound antibovine γ-globulins was used. After a non-equilibrium incubation, separation of the bound and free hormone was performed by means of dextran-coated charcoal. Elevated parathyroid hormone levels could be demonstrated in different forms of primary and secondary hyperparathyroidism (chronic renal failure, rachitis, full-term pregnancy, hypothyroidism, pseudohypoparathyroidism). (auth)

972 RADIOIMMUNOLOGICAL DETERMINATION OF HUMAN CALCITONIN. Heynen, G.; Franchimont, P.; Gaspar, S. (Univ., Liege). pp 367-380 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974). (In French).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol. 1); CONF-7309119-(P1).

The authors have developed a system for radioimmunological measurement of human calcitonin (CT), analyzing each individual stage of the process in detail. The system is very sensitive, since it permits the detection of quantities of 10 pg/ml of serum, using a reference curve plotted in the presence of human serum proteins. The specificity of the system is definitively established on the basis of immunological and biological criteria. The technique is sensitive enough for studying calcitonin secretion mechanisms in normal humans and humans suffering from certain pathological conditions. The authors found high levels in primary and secondary hyperparathyroidism as well as Biermer's anaemia, and also in a case of the Zollinger-Ellison syndrome. Induced hypercalcemia increases, and the hypocalcemia induced by EDTA decreases, the secretion of calcitonin. (auth)

973 RADIOIMMUNOLOGICAL DETERMINATION OF HUMAN CALCITONIN: IMMUNOCHEMICAL STUDY AND COMPARISON OF THE RESULTS WITH THOSE OF BIOLOGICAL DETERMINATIONS. Moukhtar, M. S.; Jullienne, A.; Rivaille, P.; Milhaud, G. (Faculte de Medecine Saint-Antoine, Paris). pp 381-397 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974). (In French).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol. 1); CONF-7309119-(P1).

The authors have developed a sensitive and specific system for radioimmunological determination of human calcitonin which involves immunizing guinea pigs and rats with small doses of extractive human hormone. The immunoreactive sites were determined with the aid of various peptide fragments synthesized by the solid phase technique. In normal patients, the circulating levels were measured either directly or after extraction and concentration in an affinity column (with the antibodies fixed on Sepharose). In the case of tissues, the correlation between the results of biological and radioimmunological determinations is very good, thereby indicating that the complete molecule is present; it is only the intact hormone (32 amino acids) that exhibits biological activity. In certain plasmas the results of radioimmunological determination are higher than biological measurements; this may be explained either by the presence of molecule fragments possessing immunochemical activity, or by an oxidized hormone. Urinary calcitonin was determined, and this made it possible to evaluate the production of this hormone in the normal state and under certain pathological conditions. (auth)

974 RADIOIMMUNOLOGICAL DETERMINATION OF GASTRIN: METHOD AND CLINICAL RESULTS. Kaess, H. (Univ., Heidelberg); Meriadec, B. pp 399-410 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974). (In French).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol. 1); CONF-7309119-(P1).

Radioimmunological measurement of gastrin permits a rapid determination of gastrinaemia with small volumes of serum or plasma. As standard the authors use synthetic human gastrin manufactured by ICI, recalibrated with respect to the international standard supplied by the Medical Research Council. The tracer (synthetic human gastrin labelled with ^{125}I by the chloramine-T method) is purified in polyacrylamide gel. The cold gastrin is thereby separated from the iodinated gastrin, so that it is possible to attain specific activities of the order of 1000 μCi/μg, with only a small percentage of di-iodinated gastrin. Antiserum was obtained from rabbits. The injected product was synthetic gastrin coupled with BSA (bovine serum albumin). The immunization system recommended by MacGuigam was adopted. Study of the cross-reactivity shows very slight interaction by pentagastrin ($<10^{-3}$), and a zero reaction with CCK (cholecystokinin) octapeptide and secretin ($<10^{-5}$). The final dilution was 1:200,000. The measurement was made with a veronal buffer, the incubation volume being 1 ml; the incubation time may be 1 hour at 37°C, and 24 or 72 hours at 4°C, depending on the sensitivity required. The samples to be measured were diluted 1:10 so as to avoid all interference by serum proteins. Two methods of separating the free and bound gastrin were used: (a) adsorption of the free gastrin on Norit A charcoal after standardization of the protein concentration in all the tubes; and (b) second antibody fixed on cellulose. The standards ranged from 0 to 400 μg/ml of serum, with a detection limit of 10 pg/ml of serum under normal conditions. This limit may be lowered by altering the incubation conditions. In this system the gastrinaemia of normal subjects on an empty stomach averages 50 pg/ml. Under the same conditions the authors determined gastrinaemia in cases of duodenal ulcer, gastric ulcer, antrectomy with or without ulcers, gastric cancer, Biermer's anaemia, and the Zollinger-Ellison syndrome. (auth)

975 COMPARATIVE EVALUATION OF RADIOIMMUNOASSAY METHODS FOR HUMAN PROLACTIN USING ANTI-OVINE AND ANTI-HUMAN PROLACTIN SERA. Badawi, M.; Bila, S.; L'Hermite, M.; Perez-Lopez, F. R.; Robyn, C. (Univ. Libre, Brussels). pp 411-422 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol. 1); CONF-7309119-(P1).

Standardization of radioimmunoassay methods for human prolactin is impaired by incomplete characterization of physicochemical and immunochemical properties of this hormone. The purpose of the present study is to compare the characteristics of four methods, an homologous ovine assay, two homologous human assays and a heterologous ovine-human assay. Highly purified ovine (LER-860-2) human pituitary prolactins (HPro Lewis 203-1; HPro V-L-S1-NIH) were labelled with ^{125}I by the chloramine-T method. Anti-ovine prolactin sera were obtained by immunization of rabbits with a semi-purified ovine prolactin preparation. Anti-human prolactin serum was raised in a rabbit by using a preparation obtained from the incubation medium of human foetal pituitaries maintained in tissue culture. Another rabbit antiserum was prepared against a highly purified pituitary preparation (antiHPro-NIH). Free hormone was separated from antibody-bound hormone by the second antibody technique. In the homologous ovine system, 90% or more inhibition of the binding of labelled ovine prolactin to all antisera occurred with unlabelled ovine prolactin. With unlabelled human serum prolactin, cross-reaction was found with all antisera, but maximal inhibition differed from one to the other, ranging from 5% to 70%. In this system, there was no parallelism between inhibition curves obtained with human serum prolactin and human pituitary prolactin. In the

homologous human and in the heterologous ovine-human systems 90% or more inhibition of the binding of labelled human prolactin to the corresponding antisera occurred with unlabelled human prolactin. Only partial inhibition was found with ovine prolactin in the homologous human assays, although complete inhibition of the binding of human prolactin to anti-ovine prolactin antibodies was obtained with ovine prolactin in the heterologous assay. In the homologous human, in the homologous ovine and in the the heterologous ovine-human radioimmunoassays, no significant cross-reactions were found with human growth hormone or with human chorionic somatomammotropin. Sensitivity is similar for the four assay methods. Precision evaluated by the index of precision of standard inhibition curves is greater for the homologous ovine-human assay. Basal levels of prolactin as measured in serum by the homologous ovine assay were 2 to 3 times higher than those found by the homologous human assays, although the amplitude of the prolactin response to TRH and CB 154 were similar with both methods. Such data indicate that these two types of radioimmunoassay do not measure the same immunoreactive prolactin. (auth)

976 RADIOIMMUNOASSAY OF ANGIOTENSIN II. Wolf, R. L.; Gherman, C. E.; Mendlowitz, M. (City Univ. of New York). pp 423-428 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol. 1); CONF-7309119-(P1).

In order to assay for angiotensin II, a specific and sensitive radioimmunoassay technique has been developed employing paper radioelectrophoresis and antibody to angiotensin II coupled to poly-L-lysine via its carboxyl-terminal phenylalanine (A-(Phe)-PL). Mixtures of rabbit A-(Phe)-PL-antibody (30 μl), angiotensin II-^{131}I(1.0 ng) and varying amounts of angiotensin II were refrigerated at 4°C for 24 h. Aliquots of the mixture were applied to the cathode ends of strips of Whatman No. 3 MM filter paper measuring 35 mm × 500 mm. Radioelectrophoresis was effected in a constant-temperature room at 4°C for 18 h at 200 V employing a barbital buffer at pH 8.6, ionic strength 0.1. The strips were assayed for radioactivity in an automatic strip scanner using a linear ratemeter with an integrating count circuit. Naphthalene black stain and 10% acetic acid in methyl alcohol were used to color the proteins on the strips. Antibody-bound (B) angiotensin II-^{131}I radioactivity migrated with the mobility of γ-globulin; free (F) angiotensin II-^{131}I radioactivity migrated more rapidly in the anodal direction. When the ratio: B/F angiotensin II-^{131}I was plotted as a function of angiotensin II concentration, the results indicated that angiotensin II was detected in picogram quantities. It is concluded that this radioimmunoassay technique may be used for the measurement of angiotensin II in the body fluids. (auth)

977 SIMPLIFIED RADIOIMMUNOASSAY FOR PLASMA ANGIOTENSIN II. Nussberger, J.; Beckerhoff, R.; Vetter, W.; Armbruster, H.; Siegenthaler, W. (Univ., Zurich). pp 429-436 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol. 1); CONF-7309119-(P1).

A sensitive antiserum against Asp^1-Ileu^5-angiotensin II was elicited by immunization of a rabbit with a Asp^1-Ileu^5-angiotensin II-RSA complex. Diluted 1:10,000 the serum allowed the detection of 2 pg of angiotensin. The cross-reaction with des-1-angiotensin II heptapeptide was 51% and with des-1,2-angiotensin II hexapeptide it was 42%. In order to remove plasma proteins which may interfere non-specifically in radioimmunoassay systems, 9 ml of cold ethanol were added to 1.5 ml of cold EDTA-plasma. After centrifugation the supernatant was dried under air and the residue dissolved in 1.5 ml of buffer. 0.5 ml of this solution was assayed in duplicate. Standard methods were applied to label A-II (by means of chloramine-T) and to separate antibody-bound from free hormone (by means of dextran-coated charcoal). The recovery of A-II added to hormone-free plasma was 63 ± 6% (n = 32). The blank of A-II free plasma was always zero. Serial dilutions of plasma superimposed the standard curve. The minimum concentration which could be measured was 6 pg/ml. Additional experiments confirmed that interference with substances other than A-II was very unlikely. A-II concentrations in venous plasma of 42 male subjects on uncontrolled diet ranged from less than 6 pg/ml to 28 pg/ml. Increase in plasma A-II corresponding to that in renin activity was observed after orthostasis and after i.v. injection of furosemide. No A-II was detectable in three patients with primary aldosteronism. Compared with methods previously published the presented assay for A-II allows the measurement of the peptide in relatively small amounts of plasma avoiding time-consuming extraction and concentration procedures. (auth)

978 RADIOIMMUNOASSAY MEASUREMENT OF PROSTAGLANDINS F_α IN PLASMA. Charbonnel, B.; Soubrier, A.; Dray, F. (Institut Pasteur, Paris). pp 437-450 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974). (In French).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol. 1); CONF-7309119-(P1).

Antibodies with high affinity (K = 6.1×10^9 l/mole) were produced in rabbits immunized with a conjugate of $PGF_{2\alpha}$ linked to BSA by reaction with carbodiimide reagent. A radioimmunoassay was developed in which dextran-coated charcoal was used to separate the free from the antibody-bound $PGF_{1\alpha}$ ^{3}H. The sensitivity of the method is about 7 pg. Plasma samples (10 ml or more at pH 3) were extracted with cyclohexane: ethyl acetate (1:1) and then the extract was chromatographed on a small silicic acid column to separate PGF from various PG and especially non-specific lipids. This method of extraction and purification gave an approximately 80% recovery of $PGF_{1\alpha}$ ^{3}H. The mean plasma PGF_α levels, which are much lower than those published, were found to be: 9.3 ± 3.5 pg/ml in 18 adult males; 6.38 ± 2.7 pg/ml in 11 adult females in the follicular phase; 5.7 ± 2.3 pg/ml in 12 adult females in the luteal phase; 8.2 ± 1.5 pg/ml in 11 plasma assays and 31.3 ± 15 pg/ml in 11 corresponding serum assays (these results being significantly different with $p < 0.01$). The mean PGF level in seminal fluid was found to be 5.88 ± 1.7 μg/ml. The authors explain the need for extreme care and standardization in collecting blood samples and especially emphasize that the blood must be centrifuged immediately after sampling to ensure complete removal of blood cells and platelets. (auth)

979 RADIOIMMUNOASSAY OF THE HYPOTHALAMIC RELEASING HORMONES, LH-RH AND TRH, IN BLOOD AND URINE. Jeffcoate, S. L. (St. Thomas's Hospital Medical School, London); Fraser, H. M.; Gunn, A.; Holland, D. T.; White, N. pp 463-469 of Vienna; International Atomic Energy Agency (Mar 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol. 1); CONF-7309119-(P1).

Antisera to various conjugates of LH-RH and TRH with albumin have been prepared in rabbits, guinea-pigs, and rats. By using these antisera and ^{125}I-labelled peptides radioimmunoassays were developed for LH-RH and TRH and applied to their measurement in blood and urine samples from human subjects and other species. (auth)

980 IMMUNOLOGICAL AND BIOLOGICAL SPECIFICITY OF A RADIOIMMUNOASSAY FOR PROSTAGLANDINS OF THE F GROUP (PGF). Patrono, C.; Ciabattoni, G. (Univ. Cattolica del S. Cuore, Rome). pp 451-461 of Radioimmunoassay and Related Procedures in Medicine. Vol. I. Vienna; International Atomic Energy Agency (Mar 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol. 1); CONF-7309119-(P1).

The specificity of a previously reported radioimmunoassay for PGF has been tested by means of immunological and biological criteria. The sensitivity of the antiserum (5 pg/ml) enabeled human plasma samples to be assayed at a 1:10 dilution. Under these conditions, standard curves obtained in 0.02M phosphate buffer were superimposable on those obtained in PGF-free plasma over a wide range of concentrations. In the case of a few plasma samples tested over a 10-fold range of dilution, the immunochemical behavior of endogenous PGF could not be distinguished from the standard $PGF_{2\alpha}$. Plasma levels of PGF in human subjects, under basal conditions as well as during spontaneous uterine contractions, are well within the range which had been predicted on the basis of mass spectrometric studies on the production rate of $PGF_{2\alpha}$. The in-vitro release of PGF from the isolated rat uterus during continuous superfusion was also studied. Oestradiol was found to increase PGF concentration in the superfusate. Fenoprofen, a non-steroid antiinflammatory drug, was found to inhibit the spontaneous as well as the oestradiol induced PGF release. In addition, aspirin completely suppressed PGF formation during the aggregation of rabbit platelets. It is concluded that the method gives a reliable measure of PGF concentration in biological fluids, and is suitable for physiological studies of these substances. (auth)

981 RADIOIMMUNOASSAY OF STEROIDS IN BIOLOGICAL MATERIALS. Abraham, G. E. (Harbor General Hospital, Torrance, CA). pp 3-29 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol.2); CONF-7309119-(P2).

The principle of radioimmunoassay is based on the reversible interaction between small portions of two reagents: the haptenic sites of antigens and the antibody-binding sites of antibodies. The haptenic groups that react with the antibody-binding sites are relatively small (about the size of a tetra-peptide). Immunization of animals with molecules the size of such haptens fails to show any detectable immunological response. However, when these haptens are covalently coupled to protein carriers, they become immunogenic. Since steriods and their conjugates have molecular weights much below 1000, they are not immunogenic. However, when covalently coupled to protein carriers, they become immunogenic, acting as haptens. Strong covalent bonds between the steroid and the protein are required to prevent in-vivo lysis of these bonds during immunization. Peptide bonds are biologically stable. To prepare such bonds, a free carboxyl group is attached to the steroid molecule using the hydroxyl and ketone groups of the steroid molecule as anchoring points. Peptide bonds are formed between these carboxyl groups and the ϵ-amino groups of lysine residue of albumin. The immune response to steroid-protein conjugates depends, among others, on: (1) method and duration of immunization; (2) the carrier protein; (3) the steroid-protein molar ratio; and (4) the site of steroid linkage to the protein. Because of the multiplicity of closely related steroids in biological fluids, some form of chromatographic purification is usually required to obtain specificity. The degree of purification depends on: (1) the specificity of the antiserum used; (2) the relative concentration of the interfering steroids in the biological fluid; and (3) the nonspecific interference by plasma lipids and proteins. For some steroids with unique configuration and for synthetic steroids not normally present in biological fluids, it may be possible to perform the assay directly, without extraction and chromatography. Also, if a particular steroid exists in a particular biological fluid in relatively large concentration compared with related interfering steroids, it may be measured directly. As of this writing, the principle of radioimmunoassay has been applied to the measurement of every known hormonal steroid and to many other steroids without known biological activity. Because of the ease of performance, radioimmunoassay lends itself to automation and such an adaptation for the measurement of steroids ought to be forthcoming. (auth)

982 IODINE-125 TRACERS IN STEROID RADIOIMMUNOASSAY. Edwards, R.; Gilby, E. D.; Jeffcoate, S. L. (St. Thomas's Hospital, London). pp 31-40 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol.2); CONF-7309119-(P2).

The use of ^{3}H- and ^{125}I-tracers in steroid radioimmunoassays has been compared with regard to the effect of the tracers on the sensitivity, precision, and specificity of the assay. The use of histamine-^{125}I conjugates as stable tracers with high affinity for steroid antisera is described. There is also evidence for a reduced affinity of ^{3}H-steroids compared with unlabelled steroids. (auth)

983 TESTOSTERONE AND OESTRADIOL RADIOIMMUNOASSAYS AND THEIR APPLICATION TO THE STUDY OF GONADAL FUNCTION IN CHILDREN. Rivarola, M. A.; de Lazzari, M. E. E. (Hospital de Ninos, Buenos Aires). pp 41-46 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol.2); CONF-7309119-(P2).

From testosterone radioimmunoassay, antitestosterone antibodies were prepared in a sheep by weekly injections of 4 mg of a bovine serum albumin conjugate of testosterone-3-(o-carboxymethyl)oxime dissolved in Freund's adjuvant. For the assay, the unknown sera, to which ^{3}H-testosterone had been previously added to allow for correction losses, were purified by precipitation with ammonium sulphate followed by redilution of the precipitate and extraction with hexane-ethyl acetate. The antiserum was used in a final dilution of 1:2000. Free and bound fractions were separated by dextran-coated charcoal. The specificity of the assay was such that 77% of dihydrotestosterone and 23% of 5 α-androstan-3α, 17β-diol could be measured as testosterone in this method. Normal values for prepubertal and postpubertal children were, however, similar to those of other more specific methods. The antibody for oestradiol radioimmunoassay was a gift of G. E. Abraham. Preliminary purification was carried out using a celite-ethyleneglycol microcolumn. The antiserum was used in a final dilution of 1:45000. Free and bound fractions were separated with dextran-coated charcoal. Mean oestradiol values were: normal prepubertal girls, 3.3 pg/ml; pubertal girls, 25.1; adult women, 162; precocious telarche, 8.4; precocious puberty 89. The two methods described are useful for studying sexual function in children and adults. (auth)

984 VIROIMMUNOASSAY OF 17 β-OESTRADIOL. Andrieu, J. M.; Mamas, S.; Dray, F. (Institut Pasteur, Paris). pp 47-55 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1974). See STI/PUB-350 (Vol.2); CONF-7309119-(P2).

Bacteriophage T4 has been conjugated by covalent binding with 17 β-oestradiol. The modified bacteriophages surviving the coupling process were neutralized in diluted anticestradiol antiserum according to first-order kinetics. This neutralization may be prevented by 17 β-oestradiol. When the assay was performed at 0°C it was possible to detect as little as 0.7 pg of oestradiol whereas radioimmunoassay with the same antiserum could only quantitate 20 pg of oestradiol. The authors believe this to be an extremely sensitive assay which may be extended to other haptens or antigens. (auth)

985 TOTAL AND UNCONJUGATED SERUM OESTRIOL LEVELS AS A TEST OF FOETO-PLACENTAL FUNCTION. Stafford, J. E. H.; Watson, D. (King Edward VII Hospital, Windsor, Eng.). pp 57-66 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol.2); CONF-7309119-(P2).

In a search for a better way of monitoring foeto-placental adequacy, we examined the total and the unconjugated oestriol concentrations in the blood serum during the last quarter of pregnancy. A radioimmunoassay method was developed capable of giving a same-day result and yielding 40 sample results per day per technician. Optimum conditions were worked out, and good specificity and within-assay and between-assay variations of 7% for total and unconjugated oestriol were achieved. By this technique serum total oestriol levels in healthy terminal pregnancies were 60 to 490 μg/litre. The authors are not aware of any previously published values obtained by radioimmunoassay. Serum unconjugated oestriol was determined by omission of the hydrolysis step. The values obtained showed a range of 6 to 26 μg/litre at term. Two hundred tests were performed, weekly, on 34 normal volunteer pregnant mothers from the 34th week of gestation until delivery. The mean serum total oestriol level doubled during the last 6 weeks of pregnancy reaching a plateau at weeks 38 to 41. A group of abnormal pregnancies was also studied on which four additional tests of foeto-placental function were also carried out- simultaneously. These were serum placental lactogen by radioimmunoassay, serum cysteine aminopeptidase by rate-reaction recording, and serum placental alkaline phosphatase and urine oestrogens by classical methods. An evaluation of the relative merits of these laboratory tests in the hospitalized pregnancies with abnormal outcome was made. Of the available laboratory tests, serial urine oestriol and plasma oestriol monitoring by radioimmunoassay proved the most useful warning indicators in late pregnancy. (auth)

986 SERUM LEVELS IN PROGESTERONE AND CHORIONIC SOMATOMAMMOTROPIN IN HUMAN PREGNANCY DETERMINED BY RADIOIMMUNOLOGICAL METHODS. Bauminger, S. (Weizmann Institute of Science, Rehovot, Israel); Cordova, T.; Ayalon, D.; Friedlander, A.; Schwartz, A.; Peyser, M. R.; Toaff, R.; Harell, A.; Lindner, H. R. pp 67-77 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol.2); CONF-7309119-(P2).

The purpose of this study was to define the relation between serum levels of progesterone (P) and human chorionic somatomammotropin (HCS) throughout normal pregnancy. Progesterone-levels were estimated by radioimmunoassay using an antiserum raised in rabbits by immunization with a conjugate of progesterone-6-carboxymethylene-thioether bovine serum albumin (P-6-CMTE-BSA). This antiserum does not cross-react with 20α- or 20β-hydroxyprogesterone nor with 17-hydroxyprogesterone, which are present in substantial amounts in pregnancy serum. The assays were carried out on petroleum-ether extracts of serum without a preliminary chromatographic step, since purification of the extracts by paper chromatography did not significantly alter the results. In normal pregnant women, serum progesterone

increased gradually from a level of 8.3 ± 2.4 ng/ml (mean ± SEM; n = 6) during the 7th week of gestation to 14.3 ± 1.32 ng/ml (n = 5) at 15 weeks, and thereafter rose more rapidly to reach 74.3 ± 13.2 ng/ml (n = 5) toward term. HCS levels showed a similar pattern, rising from 53 ± 24 ng/ml in week 7 to 1.4 ± 0.08 μg/ml in the 15th week and 11.3 ± 1.9 μg/ml before delivery. The progesterone to HCS ratio (ng:μg) decreased from 518 ± 248 at week 5 to 10.9 ± 1.2 at week 15 and remained fairly constant from week 15 onwards (correlation coefficient r = 0.69; $p < 0.001$). The high and variable progesterone to HCS ratio during the first weeks of pregnancy probably reflects the ovarian contribution to progesterone production, whereas HCS is solely secreted by the placenta. Further study is needed to examine whether deviation from the relationship between the two hormones observed in normal pregnancies may be indicative of placental pathology. (auth)

987 SPECIFICITY OF ANTISERA TO ALDOSTERONE AND DEOXYCORTICOSTERONE (DOC). Newsome, H. H.; Clements, A. S.; Hume, D. M. (Medical Coll. of Virginia, Richmond). pp 79-85 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol.2); CONF-7309119-(P2).

Both immunological specificity and non-specificity can be useful characteristics of antisera. The well-known usefulness of specificity is illustrated by an antiserum we have raised in rabbits to aldosterone coupled at the C-21 position by carbodiimide condensation with human gamma globulin (hGG). The sensitivity of the antiserum is such that approximately 15 pg of standard aldosterone will displace 25% of ^{3}H-aldo from the antibody. Amounts of other steroids required for a comparable displacement are as follows: DOC 1200 pg, 18-OH DOC 1500 pg, corticosterone (B) 1600 pg, deoxycortisol (S) 1900 pg, and cortisol (F) 30 000 pg. Since these other major steroids cross-react very little, only a one-step purification of plasma samples (LH-20 Sephadex chromatography) is required for use of the antiserum in a clinical radioimmunoassay. On the other hand, usefulness of non-specificity can be demonstrated by an antiserum developed from a C-21 DOC-hGG conjugate by our previously reported method. From this antiserum 25% of ^{3}H-DOC can be displaced by 25 pg of standard DOC. The binding characteristics of this antiserum with other steroids is such that progesterone, 20-α-dihydroprogesterone, 17-OH progesterone, corticosterone, deoxycortisol, testosterone, and dihydrotestosterone can be quantitated in small amounts of plasma at low normal ranges. Several purification steps for the plasma sample are necessary to confer specificity to the assay of each steroid, but the cross-reactivity of the antiserum allows displacement of 25% of ^{3}H-DOC from the antibody with amounts of these other steroids as follows: progesterone 25 pg, B 70 pg, 18-OH DOC 90 pg, aldosterone 120 pg, dihydrotestosterone 290 pg, 20-α-dihydroprogesterone 300 pg, 17-OH progesterone 635 pg, S 850 pg, testosterone 900 pg, dehydroepiandrosterone > 1000 pg, and F > 1000 pg. The 17-OH function appears to have more effect on cross-reactivity than do the 11-OH, 18-OH, or 11-18 hemi-acetal. Although the sensitivity of the antiserum varies somewhat with three different buffers tested, the relative specificities of the antiserum for the steroids were unaffected by the buffers. Although a high specificity is generally sought in selecting antisera, a steroid with relatively few substituent groups can be used to produce a sensitive, non-specific antiserum which can be used to quantitate many other steroids. (auth)

988 PREPARATION OF AN ANTISERUM SPECIFIC TO ALDOSTERONE AND ITS APPLICATION IN RADIOIMMUNOASSAY. Vetter, H. (Univ., Bonn); Vetter, W.; Siegenthaler, W. pp 87-96 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol.2); CONF-7309119-(P2).

A highly sensitive and specific antiserum was obtained by immunizing a rabbit with an aldosterone-carboxymethoxime bovine gamma globulin conjugate. Immunological analysis of antisera collected 6, 9, 13, and 23 weeks after the first immunization revealed that the serum from week 23 had the highest sensitivity and specificity. Cross-reaction of this antiserum with cortisol was 0.0008%, with corticosterone 0.06%, desoxycorticosterone 0.10%, 18-OH-corticosterone 0.020%, 18-OH-desoxycorticosterone 0.045%, progesterone 0.0015%, and testosterone 0.0015%. The antiserum was used to determine the concentration of aldosterone in plasma and in urine. Urine that had been pre-extracted with methylene chloride was submitted to acid hydrolysis for 24 h. This was followed by a methylene chloride extraction and the methylene chloride extract was dried and redissolved in buffer before use in the radioimmunoassay. No special technique was employed to separate the aldosterone from other naturally occurring steroid hormones. Except for the acid hydrolysis, a similar procedure was used to measure the concentration of aldosterone in plasma. For the determination in urine the coefficient of variation for between-assay determinations was 12.5% and for the determination in plasma the coefficient of variation for between-assay determinations in two plasma pools was 11.2% and 6.8% respectively. In 10 normal subjects the urinary excretion rates for the acid-labile aldosterone-18-glucuronide ranged from 4.3 to 14.4 μg/24 h. In the same subjects the plasma aldosterone concentrations were between 40 and 102 pg/ml in the supine position and between 100 and 308 pg/ml 2 hours after changing to the upright position. Five patients with primary hyperaldosteronism had plasma aldosterone concentrations that were markedly higher than those found in plasma from normal subjects in the supine position. Only three of these patients showed elevated urinary aldosterone-18-glucuronide excretion rates. (auth)

989 STANDARDIZATION AND CONTROL OF STEROID RADIOIMMUNOASSAY. Malvano, R.; Rolleri, E.; Rosa, U. (National Research Council, Pisa, Italy). pp 97-123 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350(Vol.2); CONF-7309119-(P2).

The paper outlines the reliability criteria of steroid radioimmunoassay which stem from two major considerations: (a) the requirement of high levels of specificity in order to discriminate between closely related structures; and (b) the peculiar features of steroid antisera. Both aspects are critically viewed in the light of the criteria to be adopted for the preparation and selection of antisera and for the assay design. (auth)

990 RADIOIMMUNOASSAY FOR TRIIODOTHYRONINE AND THYROXINE IN UNEXTRACTED SERA. Methodological Aspects and Clinical Application. Meinhold, H.; Wenzel, K. W. (Freie Univ., Berlin). pp 127-139 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol.2); CONF-7309119-(P2).

The paper describes radioimmunological procedures for the measurement of triiodothyronine (T_3) and thyroxine (T_4). Highly specific antisera against T_3 and T_4 were produced by immunizing rabbits with conjugates of the hormones and bovine albumin, human albumin, and ovalbumin. The cross-reactivity of the antisera with physiologically relevant tyrosine and thyronine analogues was very low. Binding of T_3 and T_4 to TBG in unextracted serum was inhibited by the addition of 8-anilino-1-naphthalene sulphonic acid (ANS). For routine measurements the separation of free and antibody-bound hormone was performed by the double-antibody technique. Other techniques were tested for their separation properties. The influence of ANS on the binding of the hormones to TBG, as well as the cross-reactivity of ANS for the antisera used, were investigated in detail. The validity of the method has been demonstrated by recovery experiments in sera with different hormone and TBG concentrations. Measured mean T_3 concentrations (ng/ml) in normal and abnormal thyroid states were as follows: 1.15 (normals); 1.21 (normal females on oestrogens); 1.68 (pregnant women); 4.29 (hyperthyroids); 2.43 (T_3-thyrotoxics). In hypothyroidism the T_3 ranged from < 0.18 to 1.71 ng/ml. The T_4 concentrations measured by radioimmunoassay showed good correlation with those measured by conventional methods. (auth)

991 USE OF THYROXINE-BINDING ANTIBODIES FOR RAPID ESTIMATION OF TOTAL THYROXINE AND FREE THYROXINE INDEX IN HUMAN SERA. Premachandra, B. N.; Ibrahim, I. I. (Veterans Administration Hospital, St. Louis). pp 141-160 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol.2); CONF-7309119-(P2).

Simple and rapid immunoassay procedures for serum total thyroxine and free thyroxine fraction are described. For measurement of total T_4, thyroxine-binding proteins in serum (25 μl) are denatured by addition of trichloroacetic acid (0.1 ml) followed by the addition of sodium hydroxide (0.3 ml) to solubilize thyroxine which is then reacted with ^{125}I-T_4-labelled antithyroxine antiserum (0.6 ml). An anionic resin sponge is introduced into the reaction

tube at 2-4°C to abstract the displaced ^{125}I-T_4 label. The sponge ^{125}I-T_4 uptake is linearly related to T_4 in the test serum or standards. Mean T_4 values (μg/100 ml) in normal, hypothyroid and hyperthyroid sera were 7.67 (5.0-11.9), 2.98 (0.2-4.8) and 16.62 (12.4-22.7), respectively. The values were comparable to that obtained by the competitive protein-binding assay (Abbott Tetrasorb). The technique adequately satisfies all the major criteria required of an immunoassay (specificity, sensitivity and reliability). In this assay no centrifugation, evaporation, double antibody separation or other cumbersome procedures are involved, and the entire assay can be performed in the same tube in less than 90 min. Micro-amounts of test sera needed also facilitate the ready applicability of this technique for T_4 determination in infants and in small animals. For measurement of free T_4 fraction, 0.1 ml of test serum (without denaturation unlike in total T_4) is allowed to react with ^{125}I-T_4-labelled antithyroxine antiserum (0.9 ml) followed by the insertion of an anionic resin sponge in the reaction tube at 2-4°C. Sponge radioactivity which represents the displaced radioactive thyroxine from the immune serum is proportional to the unbound or free T_4 fraction in serum. The duration of contact of the resin sponge with the reactants can be readily adjusted so that the magnitude of unbound thyroxine fraction obtained equals that noted in the conventional dialysis or ultrafiltration procedures. The mean dialysable T_4 fraction in 17 normal and abnormal serum samples was 0.037 by the Sterling dialysis technique whereas the free T_4 fraction computed by immunoassay was 0.039. In normal, pregnancy, hypothyroid and hyperthyroid sera, free T_4 fractions were 0.076, 0.053, 0.066 and 0.087 respectively. Increases in free thyroxine fraction were noted with diluted human sera similar to that seen in the dialysis technique. The use of ^{125}I-T_4-labelled antithyroxine antiserum (rather than ^{125}I-T_4-labelled normal human serum) improved the specificity of the technique in that the in-vitro addition of various substances did not influence the free T_4 fraction. The product of total T_4 and free T_4 fraction (free T_4 index) showed excellent correlation with Abbott's free thyroxine index (T_7) in normal and disease states. (auth)

992 RADIOIMMUNOCHEMICAL MEASUREMENT OF THYROID HORMONES AND THYROXINE-BINDING GLOBULIN. Hesch, R. D.; Huefner, M.; Muehlen, A. V. Z.; Koebberling, J. (Univ., Goettingen, Ger.). pp 161-176 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol.2); CONF-7309119-(P2).

Methods for the radioimmunochemical determination of triiodothyronine (T_3), thyroxine (T_4) and thyroxine-binding globuline (TBG) are described. High titre, high affinity, and specific antibodies against T_3 and T_4 are raised in rabbits by immunizing with a conjugate of T_3- and T_4-methyl- or -ethylester with bovine serum albumin by means of carbodiimide. The ester group at the C-terminal inhibits coupling at this position and provides high and specific immunogenicity. Anti-sera with titres up to 1:160 000 can be obtained. Different compounds for blocking the binding of T_3 and T_4 to TBG have been investigated, namely: ANS, salicylate, benzodiazepin, and diphenylhydantoin, but they show obscure interactions with the specific antibodies and the plasma proteins, and they interfere with the separation technique. However, the same plasma gave different values when measured in different systems which explains the variations in the normal ranges of different assay systems. A system with high pH Tris-buffer (pH 8.9) and the addition of merthiolate (1:1000 wt./vol.) gave the best results for a reliable measurement of T_3 (normal range 0.8-1.5 ng/ml in unextracted plasma). No satisfactory assay for direct measurement of T_4 in unextracted plasma using TBG blocking agents could be established. High blank binding up to 25% was found, depending partly on the purity of the labelled hormone which is more critical for T_4 than T_3. Therefore, 50 μl of an extract of unknowns and standards in hormone-free plasma (charcoal treatment) and of blank plasma extracted with absolute alcohol were added directly to the assay system. (Final alcohol concentration 6.7%.) Alcohol did not interfere with the assay kinetics. The same procedure can be applied for the T_3 assay with a 0.99 correlation to the measurement using the unextracted plasma. Separation was usually performed by dextran-coated charcoal which is a very critical method. The double antibody solid-phase (DASP) system gave high precision when incubated for hours at room temperature. Finally, T_3 antibody was coupled directly to Sephadex superfine particles to perform an immunosorbent assay. Using the immunosorbent system a competitive solid-phase assay (CSPA) for TBG was established. The assay allows the TBG binding capacity to be measured with high precision. (auth)

993 CYCLIC AMP ASSAY AT A LEVEL OF 10^{-15} MOLE. Cailla, H.; Racine-Weisbuch, M.; Delaage, M. A. (CNRS, Marseille). pp 177-183 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974). (In French).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol.2); CONF-7309119-(P2).

The paper describes a new type of radioimmunoassay of cyclic AMP. The authors have synthesized several analogues of cyclic AMP and studied the specificity of different rat and rabbit anticyclic AMP antibodies. All show a remarkable affinity for 2′-O-succinyl derivatives of cyclic AMP, the affinity being 100 times higher than that for cyclic AMP itself. Taking into account this affinity the authors have submitted the samples for assay to a simple and rapid treatment which converts cyclic AMP into 2′-O-succinyl cyclic AMP with a 100% yield. Then the radioimmunoassay is performed by equilibrium dialysis. The sensitivity is increased a hundred-fold compared with that of the usual radioimmunoassay. The specificity and the reproducibility are also improved. A level of 10^{-15} mole of cyclic AMP is routinely assayed, the minimum detectable being less than 10^{-16} mole. (auth)

994 RADIOIMMUNOASSAY OF VITAMIN B_{12} USING A POLYURETHANE SPONGE AND COMPETITIVE PROTEIN-BINDING ASSAY USING LACTOBACILLUS LEICHMANNII. van de Wiel, D. F. M.; Goedemans, W. T.; de Vries, J. A.; Woldring, M. G. (State Univ., Groningen, Netherlands). pp 185-199 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol.2); CONF-7309119-(P2).

A radioimmunoassay of vitamin B_{12} is described in which the applicability of the use of a polyurethane sponge solid phase is demonstrated. Antibodies against vitamin B_{12} were elicited in rabbits by using an oil emulsion of vitamin B_{12} coupled either to intrinsic factor or covalently bound to albumin. Immunization was performed by intracutaneous injections in rabbits. Purified antibody was coupled to a polyurethane sponge by physical absorption. Coated sponges were packed in 5-ml disposable syringes between the plunger and the nozzle end. By taking up a solution to be assayed and the radioactive tracer of the compound with the syringe, the tracer and compound can start to compete for the antibody sites on the sponge. After incubation the mixture is removed from the syringe by squeezing the sponge flat with the plunger. By counting the radioactivity of the syringe the "bound" activity can be calculated. The simplicity of the handling procedure and the shape of the standard curve are demonstrated. The growth rate of Lactobacillus leichmannii is the parameter commonly used in the microbiological assay of vitamin B_{12} (the bio-assay). The uptake of ^{57}Co vitamin B_{12} by the microorganism depends on the amount of non-radioactive vitamin B_{12} present in the incubation medium. This property allows the determination of vitamin B_{12} by means of competitive protein binding, using the intact bacteria as the solid phase. (auth)

995 ESTIMATION OF SERUM FOLIC ACID WITH COMPETITIVE PROTEIN-BINDING METHOD IN BETA THALASSAEMIA. Gyftaki, H.; Loukopoulos, D.; Kesse-Elias, M.; Alevizou-Terzaki, V. (Univ., Athens). pp 201-204 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol.2); CONF-7309119-(P2).

Grossly ineffective haemopoiesis at a high expenditure of folate leads to folic acid deficiency in patients with homozygous β-thalassaemia in which megaloblastic transformations are observed. A sudden need for transfusion or an unexplained increase in transfusion requirements are indications of folate deficiency. When megaloblastic anemia supervened in thalassaemia different tests for folate deficiency were generally abnormal, i.e. formiminoglutamic acid excretion was increased and folate clearance was abnormally rapid. The serum folate level was not directly estimated. In the present study an effort was made to elucidate the occurrence of folic acid deficiency in homozygous and heterzygous β-thalassaemia patients so far as folic acid administration to these patients resulted in an increase in reticulocytes and hemoglobin level. To determine the folic acid levels a radioactive competitive protein-binding technique was employed which has been developed in our laboratory. Over 50 patients have been studied and in most of them the results revealed that the serum folic acid is below the normal levels. The results in relation to the hematological condition are discussed and interpreted. (auth)

996 ESTIMATION OF SERUM AND RED CELL FOLATE BY A SIMPLE RADIOMETRIC TECHNIQUE. Mincy, E. K.;

Wilcox, E.; Morrison, R. T. (Univ. of British Columbia, Vancouver). pp 205-220 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974).

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Estimation of serum and red cell methyl tetrahydrofolic acid (MTHFA) was performed by a simple radiometric assay on serum and whole blood samples using the folate binder in powdered cow's milk and ^{3}H-pteroylglutamic acid (^{3}HPGA) as tracer folate. Because the radiolabelled tracer folate ^{3}HPGA is bound to the milk binder with greater affinity than the biologically active form, MTHFA, which is present in standards and test serum, we have used a two-phase sequential incubation in which the final stage with the ^{3}HPGA is carried out at 4°C. While serum folate is a valuable tool in the investigation of patients with megaloblastic anemia and in patients with low serum B_{12}, the red cell folate provides a better assessment of the body folate status. We have extended the radiometric method to red cell folate using whole blood folate values and packed cell volume (hematocrit) readings. The radiometric method is not influenced by certain drugs and antibiotics which are known to interfere with the microbiologic assay (L. casei) and larger numbers of samples may be processed in one working day. In addition, this method is more economical than the microbiological methods and should integrate well into any laboratory now performing serum B_{12} determinations by radiometric methods and which possesses a liquid scintillation counter. Results of the radioassay and L. casei assay on 180 serum samples and some whole blood samples were compared. The mean radioassay results were slightly lower but, on an individual sample basis, offered essentially the same degree of diagnostic information. The test procedure was considered acceptable for routine laboratory use although we recommend that serum intended for assay by this method be preserved with a reducing agent and then frozen. (auth)

997 RADIOASSAY FOR SERUM FOLATE USING MILK PROTEIN AS LIGAND-BINDING SYSTEM. Leonard, J. P.; Taymans, F.; Beckers, C. (Univ., Louvain, Belgium). pp 221-231 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol.2); CONF-7309119-(P2).

Radioassay for serum folate can be performed by using a rapid and sensitive method based on the properties of a folate binding protein partially purified from milk. The method is based on a non-competitive assay performed in two steps: appropriate dilutions of 5-methyl-tetrahydrofolate (methyl-H_4PGA), used as a standard, or a small volume of serum to be measured, are incubated with an appropriate dilution of the milk-binder protein. Labelled folic acid (^{3}H-pteroylglutamic acid, ^{3}H-PGA, Amersham, UK, specific activity higher than 20 Ci/mmole) is then added in order to saturate the unoccupied sites. Separation of the bound and unbound folates is performed with albumin-coated charcoal. There is an inverse relationship between the amount of non-radioactive folate present in the standards or the unknowns and the bound radioactivity. Different technical aspects of the method are described. The binding capacity of the milk is highly variable, depending on the type of milk and its preparation. Partial purification of the specific binding protein provides a high ligand-binding system. The kinetics of the binding of folic acid (^{3}H-PGA) by milk is similar from 4°C to 37°C: the binding phenomenon first rapidly increases and then becomes slower, reaching a plateau after 30 min. The kinetic reaction depends on the pH (optimal pH: 5 to 8) and on the molarity of the incubation medium. Different types of charcoal, coated with different concentrations of albumin or dextran, have been compared in incubation media rich or poor in proteins. The data stressed the importance of having a sufficient amount of protein in the medium to prevent the adsorption of folic acid bound to the milk protein. When adequate concentrations of proteins are used, the time of contact between the mixture and the charcoal can be as long as 10 min without significant loss of the bound folic acid. The concentration of folate in the serum of normal subjects is 9.23 ± 3.29 ng/ml. The mean concentration in folate-deficient sera is 2.72 ± 0.89 ng/ml. The variation calculated on duplicates is 6.04 ± 4.37% within the same assay. The variability of sera assayed on two different days is 5.82 ± 4.9% for levels above 4 ng/ml and 8.38 ± 5.64% for those below 4 ng/ml. The assay can be performed within 4 hours and the sensitivity of the method is such that serum aliquots of only 10 µl are required. (auth)

998 RADIOIMMUNOASSAY OF DRUGS. Spector, S. (Roche Inst. of Molecular Biology, Nutley, NJ). pp 233-249 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol.2); CONF-7309119-(P2).

The drugs morphine, barbiturates and d-tubocurarine were coupled to a protein and the conjugate was shown to possess immunogenic properties. The method for preparing these drug-protein conjugates is described. Evidence is presented as to the specificity of the antibodies and the sensitivity of the radioimmunoassay for these drugs in various biological fluids. The method was used to obtain kinetic data of the drugs in the plasma of various animal species including man. (auth)

999 TUMOR ANTIGENS AND THEIR DETECTION IN THE SERUM: ADVANTAGE OF RADIOIMMUNOLOGICAL METHODS. Buffe, D. (Institut de Recherches sur le Cancer, Villejuif, France). pp 253-265 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974). (In French)

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol.2); CONF-7309119-(P2).

With immunological methods some fetal proteins have been detected in the sera of patients bearing tumors. Two antigens in particular have been studied because of their diagnostic specificity the α-fetoprotein found in primary liver cancer and teratoma and the carcinoembryonic antigen (CEA) found in digestive tumors. In order to get an early diagnosis, the radioimmunological techniques (autoradiography or radioimmunoassay) have been used. With these methods, α-fetoprotein is always specific for two types of tumor, hepatoma and teratoma, but α-fetoprotein has also been found in a few cases of secondary liver cancer, in some nontumoral liver diseases, and in pregnancy. 1 to 20 ng/ml have been detected in the normal adult. It is very important to repeat the tests and to study the quantitative variations. Indeed, the α-fetoprotein level is stable or increases in cases of tumor, recurrence or metastasis, and decreases during the development of benign diseases. CEA has been detected by radioimmunoassay in many cases of tumoral and non-tumoral diseases, specially in digestive tract injuries. Perhaps some glycoproteins cross-reacting with CEA are responsible for the low specificity of the test. Its value is compared with that of another glycoprotein, α_2 H-globulin. Nevertheless, the assay of CEA and other glycoproteins, whether they cross-react or not, is very important for following the residual disease. (auth)

1000 RADIOIMMUNOASSAY OF CARCINO-EMBRYONIC ANTIGEN (CEA). Franchimont, P.; Debruche, M. L.; Zangerlee, P. F.; Proyard, J. (Univ., Liege). pp 267-274 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol.2); CONF-7309119-(P2).

A method of assay of carcino-embryonic antigen (CEA) not requiring prior extraction is described. Various essential criteria for a valid radioimmunoassay have been fulfilled: the use of a preparation of labelled CEA reasonably freed of contaminants and of molecules damaged by the labelling reaction, acquisition of specific antibodies, use of an efficient system of separation of free labelled CEA from that bound to antibody (the double antibody technique) and application of the assay method to biological fluids, in particular serum. The sensitivity of this method allows the detection of 0.5 to 1 ng/ml of serum and the precision of the result is very satisfactory. In the serum of 1017 normal subjects CEA was found in 42 cases (4.2%): the levels were between 1 and 7 ng/ml. In contrast, in the serum of 62 of 90 patients with cancer of various origins, either treated or not treated, localized or disseminated, CEA was detectable in levels greater than 1 ng/ml in 69%. (auth)

1001 ASSAY OF THE CARCINO-EMBRYONIC ANTIGEN BY A DOUBLE ANTIBODY RADIOIMMUNOASSAY AND THE DEVELOPMENT OF AN ASSAY FOR NON-SPECIFIC CROSS-REACTING ANTIGEN. Laurence, D. J. R.; Stevens, U.; Darcy, D. A.; Turberville, C.; Neville, A. M. (Royal Cancer Hospital, London). pp 275-286 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974).

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The double antibody assay was modified from that of Egan and co-workers. The assay has been used routinely during the past two years and has given meaningful clinical results. Various

changes in the assay have been made to study their effects upon the assay quantitation and specificity. Methods of studying the specificity of the anti-CEA antibody include the ranking of a panel of plasmas obtained from a variety of clinical conditions and studies of cross-reaction using double diffusion and RIA methods. The authors have found that RIA titres are not reflected in the precipitation effects noted in double diffusion plates. The possible differences in the two techniques and of their antibody components are discussed. (auth)

1002 SOLID-PHASE SEPARATION TECHNIQUES FOR RADIOIMMUNOASSAYS BASED ON THE SPECIFIC NON-IMMUNE REACTIVITY OF STAPHYLOCOCCUS AUREUS. Jonsson, S.; Kronvall, G. (Univ. Lund, Sweden). pp 287-298 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol.2); CONF-7309119-(P2).

A solid-phase anti-γ-globulin reagent has been developed using the protein-A-rich Staphylococcus aureus strain Cowan I (NCTC No. 8530). The bacteria were formaldehyde-stabilized and heat-killed. They showed a γ-globulin absorbing capacity of 1.2-1.5 mg per ml of a 10% suspension which remained unchanged for months when the bacteria were stored at 4°C in phosphate buffer containing 0.02% sodium azide. The staphylococcal anti-γ-globulin reagent has been utilized in a radioimmunoassay for human α-foetoprotein. Up to 50 μl of serum is added to radiolabelled α-foetoprotein and rabbit antiserum dilution. In order to separate antibody-bound antigen from free antigen, 2 ml of 10% staphylococci suspended in buffer with 0.55 vol.% Tween-20 are added. This represents a fourfold excess of protein A with respect to the normal serum content of IgG which is bound to the staphylococci together with specific antigen-antibody complexes. The reaction is complete within minutes. Centrifugation at 2500 × g for 30 min produces a hard pellet from which the supernatant can be decanted or aspirated. No washing is required since nonspecific uptake can be kept below 7%. A particular advantage of the reagent is the fact that it can be used to detect IgG antibodies in the sample. An alternative separation technique has also been developed for use with antisera from species whose IgG reacts with protein A only to a limited extent, such as sheep, goat, horse, and chicken. Anti-γ-globulin antiserum from rabbit or guinea-pig is allowed to react with staphylococci which are then washed with buffer and treated with glutaric dialdehyde in order to obtain a covalent binding between the antibodies and the bacteria. Since no carrier serum is needed, very little staphylococcus-bound antibody has to be added in the separation step. The tubes are rotated for 1 hour at room temperature before centrifuging and decanting the supernatant. Similar immunosorbents, being resistant to 3M KCNS, have also been utilized for the purification of radiolabelled antigen. (auth)

1003 RADIOIMMUNOASSAY OF α-FOETOPROTEIN. Kurata, K. (Dainabot Radioisotope Lab. Ltd., Tokyo); Sekiguchi, K.; Takino, H.; Kato, S.; Nishi, S.; Hirai, H. (Hokkaido Univ., Sapporo). pp 299-313 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol.2); CONF-7309119-(P2).

Foetal serum contains an α-globulin called α-foetoprotein (αFP) which is not present in the serum of normal adults. αFP has become the subject of great interest because it appears specifically in the sera of hepatoma patients. Immunological tests such as micro-Ouchterlony and radial immunodiffusion have been used for the detection of this protein, but the sensitivity of these conventional methods is not sufficient to detect the very low concentration that exists in the sera of these patients. The authors have isolated and purified αFP from the serum of a patient with hepatoma as well as from a foetus by an immunochemical method. Using this highly purified αFP they have developed a radioimmunoassay system which is about 1000 times more sensitive than the conventional immunological methods. This radioimmunological method is believed to be very helpful for early diagnosis of hepatoma as well as for observing the effectiveness of the therapy. The antiserum for αFP was obtained by immunizing rabbits with the protein. A portion of the antiserum was combined with the purified αFP to form an antigen-antibody complex. This complex was collected, purified, and dissociated to obtain the highly purified αFP to be used for radioiodination. As the second antibody, goat antiserum for rabbit serum globulin was used. By using the double antibody system, αFP in serum could be detected at a concentration of less than 10 ng/ml. The labelled antigen, having about 30 μCi of ^{131}I/μg, could be used for more than 2 months, when kept frozen. Solid-phase systems, in which the antibody was coupled with a plastic tube or aggregated protein, were also developed and gave similar satisfactory results. Clinical application of this system showed that the αFP could also be demonstrated in sera of patients with other liver diseases, such as hepatitis and cirrhosis, which could not be detected by other conventional methods. This finding has disproved the former concept that αFP could only exist in the sera of hepatoma patients or of pregnant women. (auth)

1004 DOUBLE ANTIBODY RADIOIMMUNOASSAY BASED ON ELECTROIMMUNODIFFUSION. Quantitation of α_1-Acid Glycoprotein in Gastric Cancer Juice. Matzku, S.; Rapp, W. (Deutsches Krebsforschungszentrum, Heidelberg). pp 315-321 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol.2); CONF-7309119-(P2).

A comparison of the protein pattern of in-vivo neutralized normal and gastric cancer juice shows characteristic differences. The most relevant difference concerns α_1-acid glycoprotein (α_1GP) which was identified by immunodiffusion in gastric cancer juice, but not in normal gastric juice. A quantitative study was carried out using a new type of double antibody radioimmunoassay. The separation of free and bound labelled antigen was carried out by electroimmunodiffusion with the second antibody (antiglobulin) system. This kind of separation was effective and reproducible. The precision coefficient lambda was 0.021 - 0.034. By adding polyethylene glycol to the incubation mixture, a sensitivity of 1 ng/ml was achieved. The mean α_1 GP concentration in native gastric juice of normal subjects was 1.0 μg/ml, compared with 28.9 μg/ml in gastric cancer juice. This difference was significant on the $p = 0.001$ level. However, some cases of high α_1 GP concentration were found in gastric ulcer as well as in various forms of chronic gastritis. We operationally defined 5 μg/ml as an upper limit of normality. By this classification positive gastric cancer juices were detected in 0/24 normal subjects, 5/47 chronic gastritis, 7/19 chronic atrophic gastritis, 9/24 chronic metaplastic gastritis, 3/17 gastric ulcer, and 17/19 gastric cancers. In a limited number of cases, antigenic differences of gastric α_1 GP as compared to serum α_1 GP were observed by the radioimmunoassay dilution curve and by immunodiffusion. (auth)

1005 RADIOIMMUNOASSAY OF α_1-ACID GLYCOPROTEIN (OROSOMUCOID) IN HUMAN GASTRIC JUICES. Bali, J. P.; Mathieu, O.; Balmes, J. L.; Marignan, R. (Laboratoire de Physique, Montpellier, France). pp 323-329 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974). (In French)

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol.2); CONF-7309119-(P).

The authors have developed a radioimmunoassay for determining the amount of plasmatic α_1-acid glycoprotein in the gastric juices of patients suffering from stomach cancer in comparison with normal persons or those suffering from benign ulcers. The orosomucoid was intentionally labelled with a low efficiency of 30% by the chloramine-T method. Purification by Sephadex G-75 and electrophoresis with polyacrylamide gel produced a very highly purified molecule containing less than 5% of the label in the form of di-iodotyrosine. Separation was carried out by the Catt method with an antiserum diluted to 1/1000. The detection limit is approximately 500 pg/ml. In patients with gastric neoplasia, the amount of orosomucoid was always greater than 60 μg/h, whereas in normal subjects it was less than 60 μg/h in 75% of cases but appreciably higher in 20% of cases. The most probable explanation for this appears to be plasmatic exudation. (auth)

1006 RESULTS OBTAINED WITH THE RADIOIMMUNOSORBENT TEST FOR IgE IN ALLERGIC AND NON-ALLERGIC DISEASES. Doepp, M.; Grebe, S.; Mueller, H.; Graul, E. H.; Brehm, K. (Univ., Giessen, Ger.). pp 331-337 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol.2); CONF-7309119-(P2).

By a simple and specific method immunoglobulin E(IgE) can be determined quantitatively with the solid-phase radioimmunosorbent test. Normally, the level of IgE in the blood is very low, but in atopic and a few other diseases highly elevated values are sometimes found. The authors have investigated the influence of the incubation time, the number of washing procedures, the pipetting errors and the shelf-life of the test kit. They measured

in duplicate the IgE levels in the serum of more than 600 patients suffering from various diseases—in particular the levels before and after specific hyposensitization treatment of hay fever and the levels in the blister fluid of urticaria. Optimal saturation was first gained after incubating the samples for 60 hours but a satisfactory determination was possible after 24 hours. Three washing procedures were found sufficient to remove the unbound labelled IgE. Reliable determinations could be made with these kits up to 6 weeks after labelling. Normal levels of IgE ranged from 10 to 530 U/ml. Between 450 and 530 U/ml there seems to be a transitional range. Cases with urticaria had levels mainly within the normal range, with a few values that exceeded 1000 U/ml. The level in the blister fluid was exactly as high as in the serum. The levels in patients suffering from psoriasis were not significantly different from those of normals and those found in patients with non-atopic eczema. The IgE levels in sera from patients with atopic eczema, extrinsic asthma and hay fever were elevated. The values of hay-fever patients decreased after specific hyposensitization treatment and also after a long persistence of the illness. Determination of the IgE level in serum is helpful in diagnosing allergic and dermatologic diseases and in distinguishing between intrinsic and extrinsic asthma. Therapeutical success can be objectivated. However, two facts should be kept in mind: firstly, serum is not the ideal medium for determining IgE, as it is a sessile antibody and, secondly, a specification of the test upon the Fab-fragments of the different allergens is necessary. (auth)

1007 DETECTION OF BACTERIAL AND VIRAL ANTIGENS AND THEIR ANTIBODIES. Habermann, E. R. (Univ., Giessen, Ger.). pp 341-353 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol.2); CONF-7309119-(P2).

Some radioimmunological procedures used in the author's laboratory are described as well as some results obtained with them in studies on bacterial antigens and their antibodies. Other techniques thought to be of special relevance for further research are discussed. (1) A radioimmunological procedure for tetanus antibodies based on the competition between free antitoxin and antitoxin covalently bound to cellulose for free ^{125}I-toxin is described. Its sensitivity is superior to that of the haemagglutination test and its specificity compares well with the mouse protection assay. The method has been used to assess the response of rabbits towards active or combined (active + passive) immunization. No difference was apparent. The mass screening of outpatients showed that the immunological status of a Middle-European population is inadequate. (2) The problems of internal and external labelling of tetanus toxin are discussed. (3) A technique for the measurement of tetanus toxin and other antigens possessing more than one antigenic determinant is described. The first step of this junction test consists of the absorption of the toxin to be measured onto solid-phase antitoxin. In the second step, the bound toxin is allowed to react with ^{125}I-antitoxin. The excess of antitoxin is removed by washing. The radioactivity of the sediment is a parameter of its toxin content. (4) The use and limitations of a solid-phase radioimmunoassay for staphylococcal α-toxin are described. (auth)

1008 DETECTION OF HEPATITIS ASSOCIATE ANTIGEN IN BLOOD FROM DONORS BY RADIOIMMUNOASSAY. A Comparative Study of Radioimmunoassay, Counterelectrophoresis and Latex Agglutination Techniques. Malamos, B.; Kostamis, P.; Constantinides, C.; Psomadakis, K.; Kehayoglou, K.; Mavrikakis, M.; Chrissikou, M. (Univ., Athens). pp 355-358 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol.2); CONF-7309119-(P2).

A comparative study was made between radioimmunoassay (RIA), counterelectrophoresis (CE), and latex agglutination (LA) for detecting hepatitis associate antigen (HAA) in blood sera from 2000 Greek donors. The RIA method detected more than twice the number of HAA-positive samples (5.4%) than the counterelectrophoresis method (2.2%). There was a 40% agreement between the HAA-positive samples detected by RIA and by LA. The sensitivity of the RIA method in detecting HAA-positive blood donors and the decrease in transmission of transfusion hepatitis by 2/3 is discussed. (auth)

1009 SOLID-PHASE RADIOIMMUNOASSAY FOR HEPATITIS B ANTIGEN AND ITS CLINICAL SIGNIFICANCE. Miller, J. P.; Kurjian, J. C. (Abbott Labs., Chicago, IL). pp 359-366 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See SIT/PUB-350 (Vol.2); CONF-7309119-(P2).

The detection of hepatitis B antigen (Australia antigen) is of considerable clinical and epidemiological importance. After the discovery of this antigen in 1964, many methods have been utilized for its detection: electron microscopy, immunodiffusion, immunoelectro-osmophoresis, complement fixation, haemagglutination and, more recently, radioimmunoassay. The radioimmunoassay system described, developed by Ling and Overby, is a direct assay utilizing a solid-phase, fixed antibody and ^{125}I-labelled specific hepatitis B virus antigen immune globulin. Antigen is first fixed to antibody-coated tubes, unbound material is removed by rinsing, and then ^{125}I-labelled antibody is added. After a second incubation, the labelled antibody is fixed to the previously bound antigen, creating an antibody-antigen-labelled antibody "sandwich" The method can be described as direct in that the final count-rate is directly related to the amount of antigen in the unknown sample. The effects of various time and temperature conditions on method sensitivity and detectability are reviewed. The radioimmunoassay procedure described has been clinically evaluated in many institutions throughout the world and is at present being used extensively for screening purposes within the United States. Results indicate a sensitivity of from 100 to 500 times that of other methods and a detectability of approximately five times as many positive units as obtained with previous methods. Duplicate reproducibility can be greater than 99% with carefully controlled technique. Detection of hepatitis B antigen is based upon statistical reference to a negative population thus providing an objective numerical yes or no answer instead of a subjective visual interpretation of results. The specificity of the solid-phase radioimmunoassay technique has been evaluated by studies on closely related materials, neutralization experiments, electron microscopy confirmation, and sub-typing confirmation of antigenic determinants. There are compelling data and findings which equate increased method sensitivity to the potential for infectivity. The final answer to the dose-response question will ultimately come from several long-term epidemiological studies which are now in progress. (auth)

1010 SIMPLIFIED AND SENSITIVE DETECTION OF ANTIBODY TO AUSTRALIA ANTIGEN USING A SOLID-PHASE RADIOIMMUNOASSAY. Leonard, J. P.; Doyen, G.; Beckers, C. (Univ. Louvain, Belgium). pp 367-375 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol.2); CONF-7309119-(P2).

A modification of a solid-phase radioimmunoassay has been developed for screening and quantitating the antibody to Australia (Au) antigen. The procedure is performed using a three-phase sequential incubation: (a) 0.1 ml of an appropriate dilution of high-titre Au-antigen-positive serum, containing known antigenic subtypes, is incubated in polypropylene test-tubes coated with non-radioactive anti-Au antibodies; this provides a simplified and rapid preparation of Au antigen, bound by the adsorbed antibodies; (b) after aspiration, 0.1 ml of standard anti-Au serum or test serum dilutions are added to each tube: the antibody present in the mixture complexes with the Au antigen; (c) the tubes are decanted and rinsed and then 0.1 ml of a ^{125}I-labelled anti-Au antibody solution is delivered into the tubes; in this condition, ^{125}I-antibodies only titrate the unoccupied antigenic sites. After washing the tube, the residual radioactivity is inversely proportional to the amount of non-radioactive antibody added. The polypropylene tubes coated with anti-Au antibodies and the ^{125}I-antibody solution are obtained from Abbott Lab. (North Chicago, USA). The immunological reaction is specific and approximately 100 times more sensitive than counterelectrophoresis. The average variation between samples measured in triplicate is 8.95 ± 4.98%. In serial experiments with the same serum, the titre remains constant. The interest of the solid-phase immunoassay has been demonstrated by studies performed in patients with hepatitis (acute and chronic phase) and in persons who had received repeated blood transfusions. The method proposed here is simple to perform and does not require manipulations of high concentration of Au antigen. (auth)

1011 DETECTION OF THE AUSTRALIA (Au) ANTIGEN IN GREECE BY SOLID-PHASE RADIOIMMUNOASSAY. Koutoulidis, C.; Papaevangelou, G.; Kremastinou, T.; Panopoulos, M.; Pavlidis, E. (Univ., Athens). pp 377-383 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974). (In French)

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol.2); CONF-7309119-(P2).

Solid-phase radioimmunoassay for detecting the Au antigen, characteristic of viral hepatitis B, was compared with the conventional techniques of immunodiffusion and complement fixation on the serum of 234 cases of sporadic viral hepatitis. Immunodiffusion detected 103 sera (44. 0%) that were positive for Au antigen, complement fixation 136 (58. 1%) and radioimmunoassay 161 (68. 8%). The titres of the latter method corresponded in ratio to those of immunodiffusion but were 3389 times higher. Solid-phase radioimmunoassay was also used for detecting the Au antigen in 314 healthy subjects, consisting of 251 men (230 young soldiers) and 63 women. The Au antigen was detected in 12 sera (3. 8%) by immunodiffusion and in 26 sera (8. 2%) by radioimmunoassay. Thus, solid-phase radioimmunoassay is a simple and very sensitive method of assaying the Au antigen. It is especially suitable for eliminating blood donors carrying this antigen, of whom there is a very high percentage in Greece. (auth)

1012 SOLID-PHASE RADIOIMMUNOASSAY OF HEPATITIS B ANTIGEN. Its Usefulness in Diagnosing Acute Viral Hepatitis and Chronic Hepatitis Development. Schiano, G.; Arcieri, G.; Monacelli, M.; De Bac, C.; Franco, E. (Univ., Rome). pp 385-387 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol.2); CONF-7309119-(P2).

Hepatitis B antigen (HB Ag) was tested by solid-phase radioimmunoassay (Austria-125 Abbott) in 271 cases of acute viral hepatitis. The percentage of HB Ag positive cases was twice that found by immunodiffusion (ID). In 80% of the HB Ag positive patients transmission of the infection had been by the parenteral route. The average persistence of HB Ag detected by RIA was 40 days which was much longer than that revealed by ID (18 days). From these studies it can be concluded that: (a) HB Ag may be preferentially detected by RIA, because of its greater sensitivity; and (b) when the test result remains positive for a long time one can recognize the persistence of viral infection and development of chronic hepatitis more easily. (auth)

1013 DETECTION OF AUSTRALIA ANTIGEN BY IMMUNORADIOMETRIC ASSAY AND OTHER METHODS. A Comparative Study. Vyzantiadis, A.; Danielidis, B.; Liatsis, J.; Valtis, D. (Univ. of Thessaloniki, Greece). pp 389-398 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974).

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol.2); CONF-7309119-(P2).

The solid-phase "Austria-125" immunoradiometric assay (IRMA) was compared with counterimmunoelectrophoresis (CIEP), immunodiffusion (ID), latex agglutination (LA), and complement fixation (CF) in 383 sera from patients with viral hepatitis and other diseases. The overall positivity was 46% by IRMA, 19% by CIEP, 7% by ID, and 25% by LA. Of sera positive by IRMA, 39% were positive also by CIEP, 14% by ID, and 34% by LA. Methodological details are discussed and serial dilutions of positive sera in buffer or in negative serum are tested by IRMA, CIEP, and CF. The possibility of false positive results is discussed and seems to be less than 10% in sera positive by RIA. (auth)

1014 DETERMINATION OF THE SUB-TYPES D AND Y OF THE HEPATITIS B ANTIGEN BY MEANS OF LIQUID-PHASE RADIOIMMUNOASSAY. Amouch, P. J.; Drouet, J.; Courouce, A. M. (Centre National de Transfusion Sanguine, Paris). pp 399-407 of Radioimmunoassay and Related Procedures in Medicine. Vol. II. Vienna; International Atomic Energy Agency (May 1974). (In French)

From symposium on radioimmunoassay and related procedures in medicine; Istanbul, Turkey (10 Sep 1973). See STI/PUB-350 (Vol.2); CONF-7309119-(P2).

Since the discovery by Blumberg of the Australia (Au) antigen, or the antigen associated with hepatitis virus B, and the work of Walsh and Yalow, the authors developed a radioimmunoassay for this antigen at the Radioisotope Laboratory of the National Blood Transfusion Centre. By modifying this technique they were able to determine precisely the sub-types d and y amongst the five currently known, one of which, a, appears to be a common determinant. The tracer used was a radioiodinated purified hepatitis B (HB) antigen of known sub-type (identified by immunodiffusion) and the antibody employed was one which reacts with the same antigenic sub-type. An HB antigen solution, the known sub-type of which differed from that of the tracer, was added in excess to the usual radioimmunoassay system of tracer-antibody-buffer-sample. During the incubation period (18 h) the labelled antigen-antibody complexes which form do so only with the antigens whose sub-type differs from that of the HB antigen added in excess. The competition phenomenon exists between the tracer and the sample only if their sub-type is the same. The antigen-antibody complexes were separated from the free antigen by dilution and centrifuging, and their radioactivity measured. The results were plotted on a standard curve. Under these conditions radioimmunoassay can be used to detect the presence of an HB antigen in a pool of plasma, even if it includes the contribution of a donor having an HB anti-antigen antibody, provided that the antigen and the antibody have different sub-types (ad antigen and anti-ay antibody, for example). (auth)

1015 MARKING BONE FORMATION BY RADIOACTIVE SUBSTANCES IN VIVO. Georgi, P.; Kauert, C.; Stahl, A. (Univ., Heidelberg). Rev. Belge Med. Dent.; 28: No. 3, 347-350(Mar 1973). (In German).

A method for labelling the growth and reformation of bones in vivo by the use of radioactive materials is described. The method is intended to complement and not replace clinical examinations. The material used is ^{18}F, which is integrated in the apatite crystals of the bone and allows the early diagnosis of reformation zones. The method has the advantage of being harmless and easy to use. Two hours before the scintigraphic examination a solution of ^{18}F is administered to the patient intravenously. The scintigrams are analyzed and evaluated by means of a computer. Ten degrees of intensity are distinguished. On the screen of the scintigraph it is possible to fix the pulse rate of the zones desired. In order to distinguish the effects of the growth from those of the treatment, adults having relatively simple dysmorphoses were treated and they were examined several times during and after the treatment. By comparing the pulse rate in the corresponding zones, it is possible to determine the bone reformation due to the treatment. After 14 days of treatment an increase of the radiofluorine was observed indicating an increased metabolism of the bone. The local action on the teeth also induces an increase of this metabolism in the temporo-mandibular articulation. The method allows the effects of different apparatus to be compared. (tr-auth)

1016 EVALUATION OF THE ISOTOPIC ANTIGLOBULIN AND CYTOSTATIC ASSAYS FOR DETECTING IMMUNITY AGAINST SV_{40} TUMORS. Coggin, J. H. Jr.; Ambrose, K. R.; Candler, E. L.; Hannon, W. H. (Univ. of Tennessee, Knoxville). Israel J. Med. Sci.; 10: No. 8, 904-912(Aug 1974).

An evaluation was undertaken of the isotopic antiglobulin technique (IAT) and of the cytostatic antibody assay for indicating and measuring immunity against SV_{40}-induced sarcomas induced by tumor-specific transplantation antigens. Adult hamsters were immunized with SV_{40} virus or x-irradiated SV_{40} hamster tumor cells to the minimal extent required to produce transplantation resistance. The tumor-resistant animals were tested for specific immunoglobulin by radioimmunoassay (IAT) and for the presence or absence of cytostatic immunoglobulin. The results showed that there was no correlation between the presence of induced resistance to tumor challenge or virus tumor induction and the presence of an immunoglobulin detected by the IAT in the hamster model system. Antibody revealed by the IAT had some of the specific binding properties of antibody previously described by other workers to indicate the presence of tumor-associated surface antigen in the mouse, but could only be detected in response to hyperimmunization, whereas host resistance was evident even after limited sensitization. Cytostatic antibody appearance could be used as an index of the successful induction of tumor immunity with a minimal immunizing dose of SV_{40} virus or X-irradiated SV_{40} tumor cells, and correlated under the conditions of the test, with the extent of tumor resistance. (auth)

1017 SCINTISCANNING OF THE PANCREAS AND ITS CLINICAL SIGNIFICANCE. Kaneti, Y.; Romanova, A.; Ivanov, H. Suvrem. Med.; 24: No. 10, 13-17 (1973). (In Bulgarian).

An analysis was made of 399 pancreatic scintiscans of male and female patients, aged between 40 and 60 years, of whom those suffering from diseases of the pancreas were 212, of the liver and biliary ducts 79, of the digestive canal 71, and 37 with other diseases. Selenium-75-selenomethionine was administered in a dose of 3 μCi/kg body weight without any preliminary preparation and together with simultaneous photoscanning. The pancreas assumed the form of comma, hook, biscotte, horseshoe, and of the letter S. In general, a diffuse process was found in about 33 per cent, a focal process in 12.7 per cent and a focal-diffuse process in 7.7 per cent of the cases; in 16 per cent a blank pancreas was recorded. In 97 cases of chronic pancreatitis the image of the pancreas was not clearly delineated. In 41.7 per cent of the cases with biliohepatic diseases diffuse alterations of the pancreas were established. Of 17 cholecystectomized patients 10 were with diffuse changes in the pancreatic structure. Of 18 diabetic patients 17 had pathological pancreatic scintiscans. In 40 patients a parallelism between scintiscan findings and the secretin pancreozymin test was made and a correlation established in 87.5 per cent of

the cases. Of 36 cases in which an operative or post-mortem confrontation was possible, a discrepancy was found in two, 5.5 per cent. (Abstr. Bulg. Sci. Med. Lit.)

1018 CHICKEN INSULIN: RADIOIMMUNOLOGICAL CHARACTERIZATION AND ENHANCED ACTIVITY IN RAT FAT CELLS AND LIVER PLASMA MEMBRANES. Simon, J. (Centre de Recherches de Tours, Nouzilly, France); Freychet, P.; Rosselin, G. (Centre de Recherches de Tours, Nouzilly, France). Endocrinology; 95: No. 5, 1439-1449(Nov 1974).

Insulin was extracted from chicken pancreases and purified; its chemical, immunological and biological properties were investigated. The chicken insulin preparation appeared homogeneous on polyacrylamide gel electrophoresis and its amino acid composition was similar to that previously described by others. Among 21 guinea pig anti-human, anti-bovine and anti-porcine insulin sera, only one anti-porcine and two anti-human insulin sera cross-reacted with chicken insulin to a large extent. With one of them, chicken and human insulins were equipotent, on a weight basis, in competing with the binding of ^{131}I-human insulin. The use of ^{131}I-chicken insulin improved the sensitivity of the radioimmunoassay (0.02 ng of insulin/ml of incubation medium) and allowed measurement of chicken insulin within the physiological range of its plasma concentrations. Chicken insulin (40 μg/kg of body wt) lowered the blood glucose level by 25% in the chicken. In isolated rat fat cells, chicken insulin was 1.5- to 1.9-fold as potent as highly purified preparations of porcine insulin (27 IU/mg) in stimulating glucose oxidation. In rat liver plasma membranes, chicken insulin was 1.8- to 2.4-fold as potent as porcine insulin in competing with the binding of ^{125}I-porcine insulin, and 2.4-fold as potent as porcine insulin in competing with the binding of ^{125}I-chicken insulin to the insulin receptor sites. ^{125}I-chicken and ^{125}I-porcine insulins were degraded to the same extent by the liver membranes. Therefore, the enhanced biological potency observed in the rat in vitro with chicken insulin can be entirely accounted for by an increased binding affinity for the insulin receptors. (auth)

1019 PECULIARITIES OF VITAMIN B_{12}-^{58}Co METABOLISM AND DISTRIBUTION IN PREGNANT RABBITS AND EMBRYOS. Raetskaya, YU. I.; Sukhareva, V. N.; Annenkov, B. N.; Netecha, V. I.; Vybornova, S. N. pp 211-218 of Primenenie Izotopov i Yadernykh Izluchenii v Sel'skom Khozyaistve. III. Moscow; Atomizdat (1971). (In Russian)

To determine the participation of vitamin B_{12} in protein and nucleic acid synthesis, the metabolism and distribution of vitamin B_{12}-^{58}Co was studied in pregnant rabbits and their offspring. The labeled vitamin was given intravenously and tissue was taken immediately for determination of radioactivity and biochemical studies. It was shown that pregnancy caused significant changes in the vitamin distribution. On the 28th day of pregnancy the vitamin-B_{12} content of the liver was decreased 50% and in the uterus walls was increased 3- to 10-fold. The activity in the placenta was twice that in the liver. Pregnancy increases the rate of metabolism of vitamin-B_{12}. Since protein synthesis is localized in cell organelles, the distribution of vitamin B_{12} in cells was studied. In liver and placenta cells, where the metabolic function is high, localization of vitamin B_{12} affected the physiological and ontogenetic state of the animals. (tr-INIS)

1020 APPLICATION OF RADIOISOTOPES AS TRACERS IN SOLVING SOME FISH-INDUSTRY PROBLEMS. Bogoyavlenskaya, M. P.; Vel'tishcheva, I. F.; Korzinkin, G. S.; Shakhanova, I. A. pp 245-251 of Primenenie Izotopov i Yadernykh Izluchenii v Sel'skom Khozyaistve. III. Moscow; Atomizdat (1971). (In Russian)

Three types of isotopic methods are considered: (1) for study of relation of fish to abiotic factors of the medium, (2) for study of metabolism in fish, and (3) for mass tagging of young fish. Data obtained by isotopic methods were confirmed by chemical analysis of trout roe. In the blastula stage, the P content was 0.82 mg and the Ca content 0.40 mg per g of dry weight. At the end of embryo development, P was 1.70 mg and Ca, 0.64 mg. For fish growth the Mg/Ca ion ratio was more significant than the absolute Ca content of the water. Tagging of young from 0.3 to 3g and consideration of these weight groups at release and in monitored catches in the sea led to a very important conclusion concerning the possibility of decreasing the standard weight of young from 2 to 3 to 1g but not lower. This would increase hatchery efficiency. (tr-auth)

1021 RADIOIMMUNOASSAY OF PERIPHERAL PLASMA TESTOSTERONE IN MALES FROM EIGHT SPECIES USING A SPECIFIC ANTIBODY WITHOUT CHROMATOGRAPHY. Falvo, R. E.; Nalbandov, A. V. (Univ. of Illinois, Urbana). Endocrinology; 95: No. 5, 1466-1468(Nov 1974).

Testosterone was measured in pools from the peripheral plasma of adult male shrews (Suncus murinus), boars, rams, bulls, rats, mice, rabbits and men. A radioimmunoassay employing an antibody specific for testosterone and dihydrotestosterone only was used with and without Sephadex LH-20 chromatography. It was concluded that in all of the species tested with the exception of the rabbit, chromatography is not necessary to establish reliable estimations of testosterone in the peripheral plasma. (auth)

1022 EFFECT OF L-DIHYDROXYPHENYLALANINE (L-DOPA); ANESTHESIA AND SURGICAL STRESS ON THE SECRETION OF GROWTH HORMONE IN THE DOG. Lovinger, R. D.; Connors, M. H.; Kaplan, S. L.; Ganong, W. F.; Grumbach, M. M. (Univ. of California, San Francisco). Endocrinology; 95: No. 5, 1317-1321(Nov 1974).

A radioimmunoassay for canine growth hormone (cGH) is described utilizing a sensitive and specific ^{125}I-double antibody system. The assay is capable of detecting concentrations of GH as low as 0.7 ng/ml. Resting venous concentrations were 3.8 ± 0.3 ng/ml. Pentobarbital anesthesia and surgical stress failed to cause a significant increase in these values. However, the administration of L-dopa in a dose of 50 mg/kg iv caused a rapid rise in plasma GH from 1.2 to 21.6 ng/ml within 10 min, with a peak of 25.7 ng/ml at 20 min, and a slow decrease to base line values by 90 min. Continuous administration of L-dopa (a stat intravenous dose of 50 mg/kg followed by a constant infusion of 1 mg/kg/min for 2 hr) resulted in a transient rise in plasma GH concentration. After hypophysectomy, plasma GH concentration fell to less than 2 ng/ml. Thus L-dopa is a potent stimulus for the secretion of GH in the dog, as it is in man. (auth)

1023 PREPARATION OF BIOLOGICALLY ACTIVE ^{125}I-TSH. Goldfine, I. D.; Amir, S. M.; Petersen, A. W.; Ingbar, S. H. (Veterans Administration Hospital, San Francisco). Endocrinology; 95: No. 5, 1228-1233(Nov 1974).

The study was performed to determine whether iodinated bovine TSH of high specific radioactivity could be prepared by a method that would permit retention of its biological activity. Using stoichiometric concentrations of TSH, NaI, and chloramine T, the hormone was iodinated or radioiodinated to the extent of 1 iodine atom per molecule. Iodinated TSH was then purified from the reaction mixture by sequential chromatography on Sephadex G-25 and G-100. ^{127}I-TSH had full potency both in the TSH radioimmunoassay and in the McKenzie bioassay. ^{125}I-TSH also had full potency in the bioassay and at least 70% of the label bound to purified bovine thyroid membranes. These studies indicate that iodinated TSH retains biological activity when prepared by the method employed, and that radioiodinated TSH prepared in this manner is a suitable tool for studying the binding of TSH to its tissue receptors. (auth)

1024 RADIOIODINATED BRETYLIUM ANALOGS FOR MYOCARDIAL SCANNING. Counsell, R. E.; Yu, T.; Ranade, V. V.; Buswink, A. A.; Carr, E. A. Jr.; Carroll, M. (Univ. of Michigan, Ann Arbor). J. Nucl. Med.; 15: No. 11, 991-996(Nov 1974).

The ability of a radioiodinated analog of bretylium (RIBA) to concentrate in the myocardium of animals shortly after administration prompted the synthesis of other analogs in this series. Shifting the ortho iodine atom of RIBA to the meta and para positions caused a progressive decrease in the ability of these compounds to concentrate in the myocardium of rats. Followup studies with RIBA in dogs confirmed the ability of this compound to localize in cardiac tissue and at sufficient concentrations to obtain scintigrams. Moreover, the ratio of radioactivity of normal myocardium to that of infarct was sufficient to allow delineation of the latter by scintigraphy. (auth)

1025 SCAN DETECTION OF BONE MARROW INFARCTS IN SICKLE CELL DISORDERS. Alavi, A.; Bond, J. P.; Kuhl, D. E.; Creech, R. H. (Univ. of Pennsylvania, Philadelphia). J. Nucl. Med.; 15: No. 11, 1003-1007(Nov 1974).

Bone marrow infarction is a common complication of sickle cell crisis, yet is seldom proved before autopsy. Bone marrow scanning now provides an atraumatic method of earlier confirmation. Patients with sickle cell disorders were studied using scans of ^{99m}Tc-sulfur colloid to demonstrate the distribution of reticuloendothelial activity within the bone marrow. All patients with S-S pattern showed increased marrow activity with expansion to the long bones and skull. Patients with S-C and S-Thal had less expansion of the marrow. (auth)

1026 RADIONUCLIDE ANGIOGRAPHY WITH ^{99m}Tc-LABELED RED BLOOD CELLS FOR THE DETECTION OF AORTIC ANEURYSM. Ryo, U. Y.; Lee, J. I.; Zarnow, H.; Schwartz, M. P.; Pinsky, S. (Michael Reese Hospital and Medical Center, Chicago). J. Nucl. Med.; 15: No. 11, 1014-1017(Nov 1974).

After infusion of ^{99m}Tc-labeled autologous red blood cells, scintiphoto images of the heart and aorta were obtained from patients with suspected aortic aneurysm. Images of the heart chambers and the great vessels were clearly visualized on the static scintiphotos obtained up to 2 hr after the injection. A dissecting aneu-

rysm at the aortic arch in a critically ill patient and abdominal aortic aneurysms in asymptomatic patients were detected by scintiphoto. These findings were confirmed by subsequent contrast aortography or ultrasonic scan. Images can be taken repeatedly after a single injection of ^{99m}Tc-RBC and the procedure does not require a data-processing system. Radionuclide angiography using ^{99m}Tc-labeled autologous red blood cells and a γ camera appears to be a very effective and simple procedure for the detection of abnormalities in major blood vessels. (auth)

1027 ^{169}Er: AN IDEAL RADIONUCLIDE FOR IMAGING WITH PRESSURIZED MULTIWIRE PROPORTIONAL GAMMA CAMERAS. Rao, D. V.; Goodwin, P. N.; Khalil, F. L. (Yeshiva Univ., Bronx, NY). J. Nucl. Med.; 15: No. 11, 1008-1010(Nov 1974).

From consideration of tissue penetration, spatial resolution, and detector efficiency, radionuclides for imaging with multiwire proportional γ cameras should emit photons in the range of 35 to 50 keV. Reactor-produced ^{169}Er, half-life of 10.3 hr, was obtained, which emits only photons of 48 and 54 keV. As to its biologic behavior, this isotope is primarily a bone-seeker and it can be used as a tumor-localizing agent. Absorbed doses were calculated and found to be no greater than those from ^{99m}Tc. This radionuclide can also be used satisfactorily with the present scintillation cameras. (auth)

1028 ^{133}Xe VENTILATION SCANNING IMMEDIATELY FOLLOWING THE ^{99m}Tc PERFUSION SCAN. Jacobstein, J. G. (Northwestern Univ., Chicago). J. Nucl. Med.; 15: No. 11, 964-968(Nov 1974).

In performing combined ventilation-perfusion studies in patients for the diagnosis of pulmonary emboli, there are several important advantages to be gained by doing the ventilation study immediately after the perfusion scan. Yet the scatter from ^{99m}Tc is relatively intense at the 81-keV photopeak of ^{133}Xe and the possibility exists that this scatter might substantially degrade the ventilation image. For this reason the ventilation study is often done either immediately before the perfusion scan or on the following day. The ratio of ^{133}Xe ventilation counts to ^{99m}Tc background counts was calculated for 43 patients who underwent single-breath ventilation studies immediately after perfusion scanning. In addition, background subtraction procedures were performed by computer on data obtained from 21 of these patients. Unprocessed images were compared with those obtained after subtraction of the ^{99m}Tc background falling within the xenon window. Comparisons show that there is little or no image degradation due to the ^{99m}Tc scatter and that ventilation scanning can be performed immediately after the perfusion scan with a negligible loss of diagnostic information. (auth)

1029 STABILITY STUDIES AND TUMOR UPTAKE OF A TECHNETIUM–TETRACYCLINE COMPLEX. Breslow, K.; Halpern, S. E.; Schwartz, F. C.; Alazraki, N. P.; Ashburn, W. L. (Univ. of California, San Diego). J. Nucl. Med.; 15: No. 11, 987-990(Nov 1974).

The ^{99m}Tc-tetracycline complex (^{99m}TTC), a radiopharmaceutical under investigation as a tumor and myocardial infarct scanning agent, was studied in rats in reference to its radiopharmacology and biologic distribution. The effects of pH as well as $SnCl_2$ and tetracycline concentrations were the parameters researched. Within the limits investigated, pH was found to have a profound effect on the compound regarding the formation of what appeared to be a colloid. The biologic distribution of the ^{99m}TTC was affected by the colloid formation resulting in an increased liver uptake of the radiopharmaceutical. Increasing $SnCl_2$ concentration decreased the dissolution of the compound to $^{99m}TcO_4^-$. The most favorable biologic distribution noted was from the compound with a pH of 7.5, 5 mg of tetracycline/cc, and 2 mg of $SnCl_2$/5 cc of solution. The uptake of ^{99m}TTC by a transplanted rat hepatoma suggested that this radiopharmaceutical might be useful as a tumor-scanning agent. (auth)

1030 PSEUDOTUMORS IN ACUTE HEPATITIS. Winston, M. A.; Shapiro, M. (Veterans Administration Wadsworth Hospital Center, Los Angeles). J. Nucl. Med.; 15: No. 11, 1039-1040(Nov 1974).

A second case in which the finding of focal defects (pseudotumors) on hepatic scintiphotos was apparently caused by acute hepatitis is described. Resolution of these focal defects occurred following institution of corticosteroid therapy. (auth)

1031 NONSPECIFICITY OF THE RADIOCOLLOID HEPATIC HOTSPOT FOR SUPERIOR VENA CAVAL OBSTRUCTION. Hattner, R. S.; Shames, D. M. (Univ. of California, San Francisco). J. Nucl. Med.; 15: No. 11, 1041-1043(Nov 1974).

Non specificity of the radiocolloid hotspot for superior vena caval obstruction (SVCO) was illustrated with scintigraphic findings in the liver using ^{99m}Tc-sulfur colloid and ^{131}I-rose bengal in two patients. One patient with documented SVCO failed to demonstrate the hotspot whereas another with documented absence of SVCO showed the abnormality. (auth)

1032 SCINTIGRAPHIC DEMONSTRATION OF BILE LEAKAGE UTILIZING ^{131}I-ROSE BENGAL. Wiener, S. N.; Vyas, M. (Mt. Sinai Hospital of Cleveland). J. Nucl. Med.; 15: No. 11, 1044-1046(Nov 1974).

Scintillation camera images using ^{131}I-rose bengal of three cases of bile leakage induced by abscess or wounds including two bronchobiliary fistulas are reported. (auth)

1033 PSEUDOPARASAGITTAL MASSES CAUSED BY DISPLACEMENT OF THE FALX AND SUPERIOR SAGITTAL SINUS. Teplick, S. K.; Van Heertum, R. L.; Clark, R. E.; Carter, A. P. (Tripler Army Medical Center, San Francisco). J. Nucl. Med.; 15: No. 11, 1047-1049(Nov 1974).

Two cases of an off-midline position of the falx and superior sagittal sinus demonstrated on ^{99m}Tc-pertechnetate scans due to hemiatrophy are presented. In each, the brain scan simulates a parasagittal mass. Evaluation of the position of the torcular and dural sinuses is important particularly with developmental abnormalities. An eccentric position of the superior sagittal sinus should not be mistaken for abnormal parasagittal uptake. A vertex view is useful for additional evaluation of the superior sagittal sinus. The brain scan findings of hemiatrophy and other causes of displacement of the superior sagittal sinus are described. (auth)

1034 BRAIN TUMOR DETECTED BY THE NUCLEAR CEREBRAL ANGIOGRAM. Rockett, J.; Ray, M.; Moinuddin, M.; Gardner, C. (Baptist Memorial Hospital, Memphis). J. Nucl. Med.; 15: No. 11, 1050-1051(Nov 1974).

A brain tumor was detected by ^{99m}Tc-pertechnetate cerebral angiogram as an area of increased activity. Static brain images failed to show the neoplasm. (auth)

1035 FALSE-POSITIVE ^{131}I TOTAL-BODY SCANS. Tyson, J. W.; Wilkinson, R. H. Jr.; Witherspoon, L. R.; Goodrich, J. K. (Duke Univ. Medical Center, Durham, NC). J. Nucl. Med.; 15: No. 11, 1052-1053(Nov 1974).

One of three patients who had a false-positive ^{131}I total-body scan for metastatic thyroid carcinoma or recurrence is presented in detail. This false-positive scan had the appearance of recurrent neoplasm and was present on both a 5 : 1 minification image and on a 1 : 1 image of the neck and mediastinum. An esophagram demonstrated abnormal accumulation of barium in the cervical esophagus corresponding to the areas of ^{131}I accumulation. The abnormal scan was secondary to accumulations of saliva containing ^{131}I. Each of the other two cases demonstrated similar findings which disappeared following several swallows of water. Other reported and observed causes of false-positive ^{131}I total-body scans are discussed. (auth)

1036 EXTRAOSSEOUS NONCALCIFIED SOFT-TISSUE UPTAKE OF ^{99m}Tc-POLYPHOSPHATE. Chaudhuri, T. K.; Chaudhuri, T. K.; Gulesserian, H. P.; Christie, J. H.; Tonami, N. (Univ. of Iowa, Iowa City). J. Nucl. Med.; 15: No. 11, 1054-1056(Nov 1974).

Two cases of breast tumor, one of cerebral tumor, and one of soft-tissue abscess were found to accumulate ^{99m}Tc-polyphosphate. In neither of these cases was there radiographic evidence of calcification. (auth)

1037 METASTATIC CALCIFICATION DETECTED THROUGH SCANNING WITH ^{99m}Tc-POLYPHOSPHATE. Richards, A. G. (Royal Jubilee Hospital, Victoria, B.C.). J. Nucl. Med.; 15: No. 11, 1057-1060(Nov 1974).

A patient with hypercalcemia, calcinosis of the kidneys, renal failure, and a poorly differentiated malignancy of the bone marrow was found to have striking uptake of ^{99m}Tc-polyphosphate throughout the lungs and stomach. This finding, which has persisted over 9 months, appears to have been due to metastatic calcification of these organs. (auth)

1038 ALBUMIN-LOADING EFFECT: A PITFALL IN SALINE PAPER ANALYSIS OF ^{99m}Tc-ALBUMIN. Lin, M. S.; Kruse, S. L.; Goodwin, D. A.; Kriss, J. P. (Veterans Administration Hospital, Palo Alto, CA). J. Nucl. Med.; 15: No. 11, 1018-1020(Nov 1974).

A great variability was noted in a saline paper development of a ^{99m}Tc-albumin prepared by a Sn(II) method. The principal source of this variability was traced to a variable albumin loading (milligrams of albumin per square centimeter origin area). Generally, large loadings up to a limit favored the ^{99m}Tc-albumin resolution into a distinct peak away from the origin. With small loadings, the ^{99m}Tc-albumin resolved poorly tending to remain near the origin unless the paper was previously soaked with albumin. At small loadings in the range 0.02 to 0.4 mg/cm^2 on the presoaked paper, the ^{99m}Tc-albumin resolved into a distinct peak of R_f exceeding 0.80. Such loading and presoaking effects were confirmed with

^{131}I-albumin and indicated a saturable adsorption of albumin to the paper. The loading effect could constitute a major source of technical variability and should be controlled in saline analysis of a ^{99m}Tc-albumin. (auth)

1039 VISUALIZATION OF SCATTERED RADIATION ORIGINATING FROM THE HEAD. Greyson, N. D.; LeBlanc, J. (Mount Sinai Hospital, Toronto). J. Nucl. Med.; 15: No. 11, 1035-1036 (Nov 1974).

A peripheral rim of activity seen on the prone vertex view of cerebral blood flow studies was demonstrated to be an artifact caused by secondary radiation arising from the skull. (auth)

1040 LUNG UPTAKE OF ^{99m}Tc-SULFUR COLLOID SECONDARY TO INTRAPERITONEAL ENDOTOXIN. Klingensmith, W. C. III; Lovett, V. J. Jr. (Air Force Medical Center, Scott AFB, IL). J. Nucl. Med.; 15: No. 11, 1028-1031(Nov 1974).

The intraperitoneal injection of endotoxin in rats 6 hr prior to the intravenous injection of ^{99m}Tc-sulfur colloid (TcSC) results in a marked increase in lung uptake of TcSC that was easily shown on scintigrams. Previous animal studies suggest that the most likely mechanism of increased lung uptake is an increased number of macrophages in the pulmonary capillary bed, which are derived from the circulation, and that the liver and spleen are a possible source. This study indicates that, in the case of endotoxin, the liver and spleen are not the source of the postulated increased number of macrophages in the pulmonary capillary bed. (auth)

1041 IN VITRO THYROID FUNCTION TEST WITHOUT ALCOHOL EXTRACTION. Mincey, E. K.; Wilcox, M. E.; Morrison, R. T. (Univ. of British Columbia, Vancouver). J. Nucl. Med.; 15: No. 11, 1032-1034(Nov 1974).

A simplified ^{125}I tracer method for performing a dual-function competitive binding test of serum thyroxine for assessing thyroid function without the need for ethanol extraction and separate addition of unextracted serum aliquots was developed. (auth)

1042 EFFECT OF A SCATTERING MEDIUM ON GAMMA-RAY IMAGING. Ehrhardt, J. C.; Oberley, L. W.; Lensink, S. C. (Univ. of Iowa, Iowa City). J. Nucl. Med.; 15: No. 11, 943-948 (Nov 1974).

It is shown empirically that the scattering medium around a radioactive source can be considered as a separate component of the imaging system rather than as part of the source. In the approach we have taken, the MTF (modulation transfer function) of the total system is given by the product of the MTF of the scattering medium and the MTF of the collimated detector. It was also found that the transmission efficiency of the scattering medium is independent of the collimator. Experimental verification of the validity of this method has been made. It is shown how these results simplify the measurement of gamma collimator parameters. (auth)

1043 ACCURACY OF RADIONUCLIDE-CEREBRAL ANGIOGRAMS IN THE DETECTION OF CEREBRAL ARTERIOVENOUS MALFORMATIONS. Tyson, J. W.; Witherspoon, L. R.; Wilkinson, R. H. Jr.; Goodrich, J. K. (Duke Univ. Medical Center, Durham, NC). J. Nucl. Med.; 15: No. 11, 953-958(Nov 1974).

Radionuclide cerebral angiography using ^{99m}Tc-pertechnetate is demonstrated to be a sensitive screening procedure for the presence of intracerebral arteriovenous malformations. The characteristic findings are increased radionuclide activity at the site of the lesion in the arterial phase followed by a rapid decline in radionuclide activity following the venous phase. This pattern may also be observed in malignant gliomas and following cerebral infarction. The radionuclide cerebral angiogram should not be used as the sole method of establishing the diagnosis of an arteriovenous malformation. (auth)

1044 FEASIBILITY OF CONSECUTIVE-DAY SCHILLING TESTS. Grames, G. M.; Reiswig, R.; Jansen, C.; Herber, R. (Loma Linda Univ., CA). J. Nucl. Med.; 15: No. 11, 949-952 (Nov 1974).

The concept that parenteral vitamin B_{12} inhibits intestinal absorption of orally administered vitamin B_{12} has resulted in the policy that sequential Schilling tests be performed with a 3 to 4 day interval. The feasibility of performing repeat Schilling tests with shorter intervals was evaluated by studying 12 healthy volunteers. Four consecutive 24-hr collections were obtained following oral administration of labeled vitamin B_{12}: ^{57}Co on Days 1 and 4, and ^{60}Co on Day 2. The standard parenteral flushing dose of vitamin B_{12} (1 mg) was given in conjunction with each test dose of labeled vitamin B_{12}. All subjects excreted normal quantities of the test dose on the control and test days with means of 16.9%, 14.2%, and 19.8%. The latter value was corrected to 17.0% for the contribution of ^{57}Co from the first day. There was no statistically significant difference between Days 1 and 2 when analyzed by the paired two-sided Student's t-test at a level of 0.05. The results of this study indicate that it is feasible to perform serial Schilling tests not only on alternate days but also on two consecutive days. Thus patients suspected of having pernicious anemia can be studied with the baseline Schilling test on one day and the repeat Schilling test with intrinsic factor on the following day. (auth)

1045 RESOLUTION CAPABILITY OF A MULTIPROBE SYSTEM FOR DETERMINING REGIONAL LUNG PERFUSION WITH ^{133}Xe. Ramanathan, M.; Wilson, J. E. III. (Univ. of Texas, Dallas). J. Nucl. Med.; 15: No. 11, 959-963(Nov 1974).

The resolution capability of a multiprobe scintillation detector system was determined by occluding branches of the pulmonary arteries in dogs by means of a double-lumen balloon-tipped catheter. Regional pulmonary blood flow was estimated in terms of regional perfusion indices with a breath-holding method using ^{133}Xe. The perfusion studies were done before (control) and after creating the occlusion. The percent decrease in perfusion index as a result of the occlusion was calculated from experimentally obtained perfusion indices. Based on the distribution of the radioactivity present before and after the occlusion, a theoretical relationship was derived for percent decrease in perfusion index due to the occlusion. The percent decrease in perfusion index was predicted from the thickness of the occlusion, the depth from the face of the collimator to the beginning of the occlusion, the proximal distance of the lung tissue from the face of the collimator, AP diameter of the lungs, perfusion gradient per unit blood flow at the proximal edge of the lung along the axis of the collimator, and the linear attenuation coefficient of ^{133}Xe in the lung tissue. The predicted percent decrease in perfusion index correlated well with the experimentally obtained percent decrease in perfusion index. (auth)

1046 COMPARISON OF ^{86}Rb AND MICROSPHERE ESTIMATES OF LEFT VENTRICULAR BLOODFLOW DISTRIBUTION. Becker, L.; Ferreira, R.; Thomas, M. (Univ. of North Carolina, Chapel Hill). J. Nucl. Med.; 15: No. 11, 969-973(Nov 1974).

Diffusible radioactive tracers and nondiffusible microspheres were both used to estimate the distribution of left ventricular (LV) blood flow. These methods were directly compared in five open-chested dogs 1½ hr after ligation of branches of the anterior descending coronary artery. Strontium-85-labeled 15 micron-diam microspheres (RM) were injected into the left atrium and ^{86}RbCl was given intravenously; ninety seconds later the LV was excised and divided into multiple samples encompassing a wide range of flows. Tissue contents of RM and Rb, expressed relative to non-ischemic posterior wall myocardium, were not significantly different at normal flows. However, in the peri-ischemic region where RM content exceeded posterior wall, there was relatively less Rb than RM, and where RM content fell below 20% in the ischemic region, there was more Rb than RM. At normal or hyperemic flows the ratio of tracer content in the inner half to that in the outer half of the OV (I/O) was 1.04 for RM and 1.02 for Rb, not significantly different. As flow fell below 0.60 cc/min/gm, I/O declined similarly for RM and Rb, except that below 0.10 cc/min/gm, I/O was significantly higher for Rb (0.30 versus 0.16, $p < 0.005$). The results suggest that the two methods are equally suitable for measuring blood flow distribution except at high or very low flow levels where microspheres may reflect blood flow more accurately. (auth)

1047 RAPID INDEX OF FREE ACTIVITY IN PREPARATIONS OF ^{99m}Tc-ALBUMIN. Lamson, M. III; Callahan, R. J.; Castronovo, F. P. Jr.; McKusick, K. A.; Potsaid, M. S. (Massachusetts General Hospital, Boston). J. Nucl. Med.; 15: No. 11, 1061-1062 (Nov 1974).

A rapid screening method for determination of unbound ^{99m}Tc in preparations of ^{99m}Tc-albumin is described. The assay consists of measurements of radioactivity in fractions separated by trichloroacetic acid (TCA) precipitation-membrane filtration. Unbound pertechnetate is efficiently separated from labeled albumin by this method; reduced non-albumin-bound radioactivity is partially retained on the filter membrane. It is suggested that the TCA precipitation assay be used as a rapid screening procedure for free ^{99m}Tc activity prior to administration of the material. The more time-consuming gel chromatography may then be performed post-administration for more definitive assay. (auth)

1048 DYNAMIC BLOODFLOW STUDIES OF SPACE-OCCUPYING LESIONS IN THE LIVER. Ramanathan, P.; Ganatra, R. D.; Blau, M. (BARC, Bombay). J. Nucl. Med.; 15: No. 11, 1021-1024(Nov 1974).

Blood flow to space-occupying lesions in the liver was studied by scintillation camera in a series of 170 patients after injection of ^{113m}In-colloid. The curves obtained show a biphasic curve over the normal liver, absence of portal flow over a malignant lesion, and avascularity over benign lesions such as cysts or abscesses. The usefulness and limitations of this technique in

distinguishing between a benign and malignant lesion in the liver are discussed. (auth)

1049 RAPID AND ACCURATE METHOD FOR SIZING RADIOCOLLOIDS. Davis, M. A.; Jones, A. G.; Trindade, H. (Harvard Medical School, Boston). J. Nucl. Med.; 15: No. 11, 923-928(Nov 1974).

Thin polycarbonate film filters (Nuclepore) were used to determine the size distribution of ^{99}Tc-sulfur colloid preparations and the results compared with those obtained using cellulose membrane filters (Millipore) used in previous studies. Data obtained from experiments employing 0.005 and 0.05-μm ^{198}Au colloids revealed that the cellulose fibers exhibited a trapping mechanism unrelated to pore size. The effect of this finding was shown in a comparison of three commercial sulfur colloid preparations using the two types of filters. Testing of four commercial preparations using the polycarbonate filters indicates essentially similar distributions in each case with 15% of particles being less than 0.1 μm, 70% less than 0.4 μm, 80% in the range 0.1 to 1.0 μm, and 5% being greater than 1 μm. A fifth preparation showed 96% of all particles to be less than 0.4 μm in diameter. (auth)

1050 RAPID HEPATIC TURNOVER OF RADIOACTIVE HUMAN SERUM ALBUMIN IN SENSITIZED DOGS. Kitani, K.; Taplin, G. V. (Los Angeles Harbor General Hospital, Torrance, CA). J. Nucl. Med.; 15: No. 11, 938-942(Nov 1974).

Technetium-99m-HSA solutions are cleared from the plasma at slightly faster rates than ^{131}I-IHSA in normal man and in dogs. HSA solutions labeled with either ^{99m}Tc or with ^{131}I are cleared much more quickly from the plasma of dogs previously sensitized to HSA. Rapid hepatic accumulation of ^{99m}Tc-labeled HSA is demonstrable by sequential gamma camera imaging in sensitized dogs. (auth)

1051 SUCCESSFUL MODIFICATIONS FOR PANCREATIC IMAGING. Chandra, S.; Prezio, J. A. (Mercy Hospital, Buffalo). J. Nucl. Med.; 15: No. 11, 935-937(Nov 1974).

An experience with pancreatic imaging using ^{75}Se-selenomethionine in 24 patients is described using some modifications for the patient/detector position. No single position is infallible and it is suggested that more than one position be attempted in the same patient for better results. (auth)

1052 RAPID QUALITY CONTROL TEST FOR ^{99m}Tc-DTPA. Domek, N. S.; Loken, M. K. (Univ. of Minnesota, Minneapolis). Radiology; 113: No. 2, 393-396(Nov 1974).

From 59th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (25 Nov 1973).

^{99m}Tc-DTPA preparations were analyzed using an abbreviated two-column chromatographic system. Separate columns of Sephadex/saline and alumina/acetone were utilized in sequence to separate ^{99m}Tc-DTPA from both $^{99m}TcO_4^-$ and "hydrolyzed-^{99m}Tc." Control studies showed that small Sephadex columns do remove "hydrolyzed-^{99m}Tc" from a test sample, alumina is capable of binding ^{99m}Tc-DTPA, and neither column has an affinity for $^{99m}TcO_4^-$. The mini column approach has the potential for use as a routine quality control test method. (auth)

1053 NATURAL LANGUAGE INFORMATION STORAGE AND RETRIEVAL SYSTEM FOR NUCLEAR MEDICINE: TWO YEARS' EXPERIENCE. Stein, M. A.; Okubo, R.; Bennett, L. R.; Winter, J. (Univ. of California, Los Angeles). Contract AT(04-1-Gen)-12. Radiology; 113: No. 2, 387-389(Nov 1974).

For two years an information storage and retrieval system originally designed for pathology diagnoses has also been used for nuclear medicine reports. An input translator accepts the free text which is automatically indexed. A thesaurus automatically expands a search request to include related terms. Logical searches cross-referencing these two patient data files result in increased specificity of retrieved material. Expansion of the data base by laboratory and medical record summaries in natural language will further improve cross-referencing and increase specificity of searches. (auth)

1054 EARLY DIAGNOSIS OF PANCOAST'S TUMOR FACILITATED BY BONE SCANNING. Sills, M.; Pozderac, R. V. (Univ. of Michigan, Ann Arbor). Radiology; 113: No. 2, 391-392(Nov 1974).

In a patient complaining of back and shoulder pain, there was no definite evidence of a Pancoast tumor by physical examination, roentgenographic procedures, sputum cytology, electromyography, or nerve conduction studies. The early diagnosis of Pancoast's tumor was facilitated by an abnormal bone scan using ^{99m}Tc polyphosphate; this procedure led directly to biopsy and diagnosis. Bone scanning is recommended as a useful adjunct in evaluating patients suspected of having Pancoast's tumor. (auth)

1055 FALSE NEGATIVE BONE SCANS IN DISSEMINATED METASTATIC DISEASE. Thrupkaew, A. K.; Henkin, R. E.; Quinn, J. L. III. (Northwestern Univ., Chicago). Radiology; 113: No. 2, (Nov 1974).

Three patients had widespread skeletal metastases whose bone scans appeared to be normal. False negative scans were due to symmetrical increased radiopharmaceutical uptake in virtually all bones. Caution must be taken in the interpretation of bone scans in patients with malignant disease which tends to metastasize diffusely (e.g., from the breast, prostate, and lung). False negative interpretations may be avoided by viewing at least one radiograph containing bone at the time the scan is interpreted, the most practical being the admission chest film. (auth)

1056 PATHOPHYSIOLOGIC MECHANISM FOR VENTRICULAR ENTRY OF RADIOPHARMACEUTICAL AND POSSIBLE RELATION TO CHRONIC COMMUNICATING HYDROCEPHALUS. James, A. E. Jr. (Johns Hopkins Medical Institutions, Baltimore); Flor, W. J.; Merz, T.; Strecker, E. P.; Burns, B. Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 122: No. 1, 38-43(Sep 1974).

The cerebrospinal fluid (CSF) imaging pattern of ventricular entry and stasis in patients with chronic hydrocephalus has been described and documented. The cause of this ventricular penetration and the reason radiopharmaceutical remains there for prolonged time periods is not known. Radiopharmaceutical presence in the lateral ventricular area so soon after lumbar subarachnoid injection is too rapid to be explained by molecular diffusion. Neither can it be accounted for by rapid transfer into the blood and secretion by the choroid plexus, since most of the labeled substances do not readily pass the blood-CSF barrier. It is postulated that the CSF image patterns reflect the pathophysiologic changes in CSF flow and reabsorption which probably occur in chronic communicating hydrocephalus. Cisternographic images using ^{169}Yb-DTPA, correlated with gross and semiquantitative autoradiography were used to elucidate the basic mechanisms of CSF production and absorption in normal and abnormal circumstances. (CH)

1057 SYNTHESIS OF [^{14}C] STREPTOZOTOCIN AND ITS DISTRIBUTION AND EXCRETION IN THE RAT. Karunanayake, E. H.; Hearse, D. J.; Mellows, G. (Imperial Coll. of Science and Tech., London). Biochem. J.; 142: No. 3, 673-683(Sep 1974).

[^{14}C] Streptozotocin was synthesized specifically labelled at three positions in the molecule. The biological activity of synthetic streptozotocin was characterized by studies in vivo of its diabetogenic activity and its dose-response curves. After this characterization the excretion pattern of all three labelled forms of streptozotocin was studied. With [1-^{14}C]- streptozotocin and [2'-^{14}C] streptozotocin the injected radioactivity was excreted (approx. 70% and 80% respectively) mainly in the urine, the greater part of the excretion occurring in the first 6 h period; small amounts (approx. 9% and 8% respectively) were found in the faeces. In contrast, with [3'-methyl-^{14}C] streptozotocin a much smaller proportion (approx. 42%) of the injected radioactivity was excreted in the urine, the major proportion appearing in the first 6 h, whereas approx. 53% of the injected radioactivity was retained in the carcasses. In whole-body radioautographic studies very rapid renal clearance and hepatic accumulation of the injected radioactivity was observed with all three labelled forms of the drug. There was some evidence for biliary and intestinal excretion. Major differences were apparent in the tissue-distribution studies, with each of the three labelled forms, particularly with [3'-methyl-^{14}C] streptozotocin. There was no accumulation of [1-^{14}C] streptozotocin in the pancreas for the 6 h period after administration. However, with [3'-methyl-^{14}C]-streptozotocin (and also [2'-^{14}C] streptozotocin) there was evidence of some pancreatic accumulation after 2 h. The results indicate that streptozotocin is subjected to considerable metabolic transformation and to rapid renal clearance. The implication of these suggestions is evaluated with particular reference to the diabetogenic action of streptozotocin. (auth)

1058 SOLID PHASE RADIOIMMUNOASSAY FOR IDENTIFICATION OF HERPESVIRUS HOMINIS TYPES 1 AND 2 FROM CLINICAL MATERIALS. Forghani, B.; Schmidt, N. J.; Lennette, E. H. (California State Dept. of Health, Berkeley). Appl. Microbiol.; 28: No. 4, 661-667(Oct 1974).

A solid phase radioimmunoassay (RIA) was developed for typing Herpesvirus hominis (HVH) strains isolated from clinical materials, and it also proved to be applicable to the direct detection and typing of HVH antigen in human and animal brain tissue. The procedure utilized virus-infected human fetal diploid cells or brain tissue smears in the bottom of 1-dram glass vials, antigen was detected through the use of intermediate HVH antisera produced in rabbits or hamsters and cross-absorbed with the

HVH heterotype, and ^{125}I-labeled antispecies (rabbit or hamster) globulins produced in goats were used for detection of immune complexes. The cross-absorbed HVH antisera could be used at high dilutions in the RIA test, and they reacted with marked type-specificity in the RIA system. Specificity of the test was also improved by determining and using optimal concentrations of intermediate sera and of ^{125}I-labeled anti-species globulins. Results of typing HVH isolates by the RIA procedure agreed in all instances with those obtained by direct fluorescent antibody staining with cross-absorbed conjugates. The RIA procedure was effective and more sensitive than direct fluorescent antibody for demonstrating and typing HVH antigen directly in smears of infected human brain tissue. (auth)

1059 CURRENT STATUS OF TUMOR IMAGING. Lilien, D. L. (Univ. of Arizona, Tucson). J. Amer. Med. Ass.; 230: No. 5, 735-738(4 Nov 1974).

One drawback of diagnostic procedures for neoplasms utilizing nuclear medicine is that abnormalities seen on scans are usually nonspecific. For example, there are no pathognomonic features of the abnormality produced by a tumor on a brain scan with ^{99m}Tc-sodium pertechnetate when contrasted to that produced by an abscess or even an infarct. Diagnostic inferences may frequently be made by correlating the clinical history, by observing subtle variations in lesion configuration, or by the addition of delayed images or a dynamic or perfusion study to the procedure. Considerable effort has been directed toward the development of radiopharmaceuticals and techniques that are both more specific and more sensitive to delineate neoplasm. Although the ideal imaging agent has yet to be discovered, several useful new developments make it pertinent to review the area of tumor imaging. Nonspecific, limited-use agents include most of the commonly used radiopharmaceuticals. These agents are nonspecific in that both nonmalignant and malignant lesions will be visualized. Accumulation of the agent in and around the lesion would appear to be based on local disturbances in tissue physiology caused by the abnormality. Specific agents are also of limited use, since they are relatively tissue-specific. They represent attempts to exploit some difference, either qualitative or quantitative, between a tumor and the tissue from which it arises. A recent development, not yet adapted for use in humans, but successfully accomplished in animals, consists of labeling antibodies to carcinoembryonic antigen (CEA) with a radionuclide. The specificity of 19-iodocholesterol labeled with ^{131}I for adrenal tumors, and ^{67}Ga citrate and ^{111}In-bleomycin for soft tumor localization is discussed. (CH)

MATERIALS

1060 KINETIKA I MEKHANIZM KRISTALLIZATSII. (Kinetics and Mechanism of Crystallization). Sirota, N. N. (ed.). Minsk; Izdatel'stvo Nauka i Tekhnika (1973). 384p.

Data and information on these subjects are presented in 55 chapters. A separate abstract was prepared for each of two chapters selected by NSA scope. (JRD)

For abstracts of individual chapters see: 1092 and 1223.

1061 CALCULATION OF INTERPARTICLE CONTRIBUTIONS TO X-RAY SCATTERING BY A MICROCRYSTALLINE MEDIUM. Galeener, F. L.; Rodoni, M. M. (Xerox Palo Alto Research Center, CA). pp 101-108 of Amorphous and Liquid Semiconductors. Stuke, J. (ed.). London; Taylor and Francis Ltd. (1974).

From 5th international conference on amorphous and liquid semiconductors; Garmisch-Partenkirchen, Germany (3 Sep 1973).

The x-ray scattering function of a microcrystalline medium contains information about the separation of pairs of atoms whether or not both atoms reside in a single microcrystal. Nevertheless, interparticle separations do not appear in conventional treatments because the use of Debye's scattering equation assumes that neighboring microparticles have independent orientation and position. Intercrystalline effects are investigated by applying the Debye equation to composite particles made up of correlated arrays of cubic microcrystals. It is shown by example that the inclusion of correlation can alter the qualitative conclusions to be drawn from comparison of theoretical and experimental scattering functions. (auth)

1062 THEORY OF THE ELECTRON-PHONON INTERACTIONS. Moore, R. A. (Univ. of Waterloo, Ont.); Perdew, J. P.; Vosko, S. H. Can. J. Phys.; 52: No. 14, 1304-1314(15 Jul 1974).

An exact solution to the self-consistent field screening problem is presented in terms of Bloch-state matrix elements of the bare perturbation. This solution is equivalent to one given by Sham and Ziman in terms of Fourier transforms of the bare perturbation, but unlike the latter it avoids the convergence problem in momentum space that arises in the screening of the electron-phonon interaction because of the 'deep' part of the ionic potential. The new form of the solution converts naturally into a pseudopotential formalism. At the same time it provides a framework in which to discuss and extend the two most common calculation schemes for the electron-phonon matrix element, the rigid Schrödinger potential model and the diffraction model. The inverse dielectric tensor is evaluated to first-order in the pseudopotential. Local field effects cause the $Q \to 0$ limit of the electron-phonon interaction to deviate from its conventional value. (auth)

Ceramics and Cermets

Refer also to abstracts 79, 85, 171, 172, 1159, 1164, 1263, 2338, 2344, 2348, 2349, 2374, 2381, 2511, 2519, and 2553.

1063 (BDX-613-1167(Rev.)) RAPID TCR TEST METHOD FOR TANTALUM-NITRIDE RESISTIVE FILMS. Laudel, A. (Bendix Corp., Kansas City, Mo. (USA)). Oct 1974. Contract AT(29-1)-613. 23p. Dep. NTIS $4.25.

Taking two resistance readings, at room temperature and at −196°C when the substrate is submerged in liquid nitrogen provides a convenient means of measuring the temperature coefficient of resistance (TCR) of tantalum-nitride films. The liquid nitrogen provides a large, controlled temperature differential that can be used conveniently in the production environment. A digital-readout tester with only a simple nulling adjustment makes it possible to read the TCR of the film directly on the DVM indicator. This method provides the prompt TCR information feedback necessary to control the tantalum-nitride sputtering process and results in substantial time and materials savings. (auth)

1064 (EIR−258) PLUTONIUM FUEL PROGRAM. Annual Report, 1973. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). May 1974. 100p. (In German). Dep. NTIS (US Sales Only) $8.00.

Activities in the Pu fuel research program at the Swiss Federal Institute for Reactor Research are summarized. Information is included on fuel irradiation, fuel production, metallurgical compatibility, fast reactor fuels, wet-route fuel processing and LMFBR fuels. (JRD)

1065 (HEDL-SA-697) TECHNIQUES FOR SCANNING ELECTRON MICROSCOPY IN THE ADVANCED CHARACTERIZATION OF NUCLEAR MATERIALS. Mayhan, S. J. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1974. Contract AT(45-1)-2170. 21p. (CONF-740812-4). Dep. NTIS $4.25.

From 7th annual international Metallographic Society technical conference; Gatlinburg, Tennessee, USA (4 Aug 1974).

The value of scanning electron microscopy in materials characterization has been well established. However, application to the advanced characterization of nuclear fuels requires specialized preparation and handling techniques. Described are a specimen transfer cell and methods developed for its use in the examination of FFTF fuel specimens including sintered pellets, starting powders of uranium and plutonium oxides, fabrication specimens, and an irradiated pellet. These techniques are also utilized in examining materials exposed to flowing liquid sodium. Typical examples are shown. (auth)

1066 (HEDL-TME-74-12) THERMOELASTIC MATERIAL PROPERTIES CORRELATION FOR URANIUM/PLUTONIUM MIXED OXIDES. Bard, F. E.; Gneiting, B. C.; Cox, C. M. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Feb 1974. Contract AT(45-1)-2170. vp. AT.

Reported experimental data on the thermoelastic properties of uranium-plutonium mixed oxide are summarized. Recommended functions for the five independent thermoelastic coefficients of specific heat at constant deformation, thermal expansion, bulk modulus, shear modulus and thermal conductivity are presented for temperatures below melting. (16 fig., 12 tables) (auth)

1067 (HEDL-TME-74-36) SODIUM-CONCRETE REACTION TESTS. Hassberger, J. A.; Hilliard, R. K. Muhlestein, L. D. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jun 1974. Contract AT(45-1)-2170. 58p. Dep. NTIS $5.45.

Five small scale tests were performed in the Hanford Engineering Development Laboratory (HEDL) Large Sodium Fire Facility (LSFF) with the objective of measuring the rate of reaction between liquid sodium and concrete for a limited number of conditions. Two types of concrete were used: conventional (SiO_2) and high density (magnetite). The reaction with 4-in. diameter horizontal surfaces and 10-in. diameter vertical surfaces was studied by heating the sodium pool while it was in direct contact with the concrete surface and measuring the depth of penetration of sodium into the concrete after cooling. Magnetite concrete was penetrated at about 1-in. per hour; conventional concrete at about 0.5-in. per hour. Cracking occurred with the 10-in. vertical surface interface specimen, but not with the 4-in. horizontal interface specimens. The heat generation rate was estimated at 10,000 Btu/h-ft^2 for magnetite concrete at 1200°F, with a probable error of ±50%. The heat of reaction was estimated at 700 ± 350 Btu per lb of magnetite concrete. (auth)

1068 (JAERI-M-5675) CREEP STRENGTH OF THE URANIUM MONOCARBIDE CONTAINING SMALL QUANTITY OF URANIUM MONOSULFIDE. Kikuchi, A.; Fukuda, K. (Japan Atomic Energy Research Inst., Tokyo). Apr 1974. 14p. NTIS (US Sales Only).

Polycrystalline uranium monocarbide and containing 3.2 or 8.0 wt % of uranium monosulfide were prepared by arc-melting. By the stress-relaxation method, the primary creep strength was measured at temperatures up to 1460°C in a vacuum. Hot hardness of the UC matrix was also examined at temperatures up to 1100°C. The stress-relaxation curves are in the logarithmic form with typical primary creep. The creep strength increases considerably with US content. The activation volume, defined by R. Chang, varies with temperature and US content; the values calculated are from about 2×10^{-21} to 1×10^{-20} cm^3. Hot hardness of the UC matrix increases with US content, especially at high temperatures. (JA)

1069 (KFK−1988) THE DEPENDENCE OF THE FIELD PROPERTIES OF TWO-PHASE MATERIALS ON THEIR STRUCTURAL COMPOSITION. Theoretical Considerations and Experimental Verification Using the Example of the Heat Conductivity of Cermets. Schulz, B. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung; Karlsruhe Univ. (TH) (F. R. Germany). Fakultaet fuer Maschinenbau). May 1974. 178p. (In German). INIS.

19 figs.; 18 tabs.; 27 refs. With abstract.

With reference to the results of the continuum theory, it is shown in the theoretical part of the work that the conductivity of two-phase materials for all realistic microstructure (homogeneous-inhomogeneous, interstitial-penetration structure, orientated-non-orientated, spherical-irregular dispergent) can be calculated by means of physically based and self-consistent derived

equations. Limitations regarding concentration and conductivity of the phases do not apply. With the approaching of irregular particles through ellipsoids, restrictions concerning form factor and orientation are also eliminated. It is shown that the determination of independent variables, which determine the conductivity of the two-phase material, is possible on an even structure. The expansion of the mathematical physical connection on several-phase materials was carried out. Besides the verification of these connections by literature data on heat conductivity of two-phase materials, the knowledge of the theoretical part was consistently and successfully applied to experimentally obtained results of the systems UO_2–Cu, U_3O_8–Al and La_2O_3–W. (GE)

1070 (ORNL-TM-4742) REVIEW OF THERMODYNAMIC BEHAVIOR IN THE U–Pu–Th–O–C SYSTEM AND OF TRANSPORT BEHAVIOR IN HTGR FUELS. Lindemer, T. B.; de Nordwall, H. J. (Oak Ridge National Lab., Tenn. (USA)). Oct 1974. Contract W-7405-eng-26. 79p. (CF-73-7-9). Dep. NTIS $7.00.

A review is presented of the thermodynamics of carbide and oxide compounds used as HTGR fuels, the quantitative data for the migration of carbide fuels as a function of temperature and temperature gradient, and the state-of-the-art approaches currently known to exist for explanation of the migration behavior in oxide fuels. (auth)

1071 FREE ENERGY OF FORMATION OF TUNGSTEN CARBIDES AND THERMODYNAMIC PROPERTIES OF CARBON IN TUNGSTEN. Gupta, D. K. Stony Brook, NY; State Univ. of New York (1973). 97p. University Microfilms Order No. 74-6751.

Thesis (Ph. D.).

Standard free energies of formation of WC and nonstoichiometric W_2C have been determined by equilibrating mixtures of tungsten and carbide powder with pure iron rods in evacuated quartz capsules between 900 and 1375°C. Activity of carbon in tungsten and carbide mixture is obtained from the equilibrium carbon content of the iron rods. A least square fit through the experimental points gives the ΔG_f° of WC = 10,020 + 1.17T ± 100 cal/mole of C. The corrected value of ΔG_f° of stoichiometric W_2C is = −6,970 −0.735T ± 65 cal/mole of C. Using the experimental values of ΔG_f° of W_2C which is in equilibrium with W and terminal solubility of C in W, the $\Delta \bar{H}_C^\alpha$ and $\Delta \bar{S}_C^\alpha(xs)$ of carbon in solid solution have been calculated. The values are 17.127 kcal and −3.73 cal/deg respectively for one mole of carbon. The transformation of WC to W_2C at 1313°C has also been established. (Diss. Abstr. Int., B)

1072 MEASUREMENT OF OXYGEN DIFFUSION IN Dy_2O_3 AND Gd_2O_3 BY STUDYING HIGH-TEMPERATURE OXIDATION OF THE METALS. Basler, D. B.; Berard, M. F. (Ames Lab., IA). J. Amer. Ceram. Soc.; 57: No. 10, 447-449(Oct 1974).

Results of oxidation studies of Gd and Dy at P_{O_2}'s from $10^{-0.3}$ to $10^{-14.5}$ atm and temperatures from 727 to 1327°C indicate both semiconducting and ionic-conducting domains are formed in the sesquioxides. At higher temperatures, where dense coarse-grained oxide layers developed, the rate of oxidation in the high-P_{O_2} semiconducting domain yielded oxygen diffusion coefficients in Dy_2O_3 in excellent agreement with literature values derived from oxidation of partially reduced oxide single crystals. Under the same conditions, the oxidation of Gd yielded oxygen diffusion coefficients in cubic Gd_2O_3 which are considerably below literature values for monoclinic single-crystal Gd_2O_3. At lower temperatures, porous scales were formed, and apparent diffusion coefficients derived from oxidation rates show a smaller temperature dependence than at higher temperatures. At low P_{O_2}, the oxides behave as ionic conductors, and metal oxidation rates result in estimates of the electronic contribution to the electrical conductivity of the order of 10^{-6} to 10^{-7} Ω^{-1} cm^{-1}. (auth)

1073 DIRECTIONAL SOLIDIFICATION OF THE ZrO_2–MgO EUTECTIC. Kennard, F. L.; Brandt, R. C.; Stubican, V. S. (Pennsylvania State Univ., University Park). J. Amer. Ceram. Soc.; 57: No. 10, 428-431(Oct 1974).

The eutectic between ZrO_2 and MgO was located at 27 wt% MgO. Directional solidification of this composition yields MgO rods in a cubic ZrO_2 matrix. Plane front growth occurred at solidification rates of <2.0 cm/h. The interfiber spacing was proportional to the inverse square root of the solidification rate. In samples where cellular growth occurred, the colony size was not affected by the solidification rate. The room-temperature fracture strength, ≈23,000 psi, which was not affected by the MgO fiber size, was controlled by the colony size. Annealing for 24 h at 1200°C increased the fracture strength by 50% as a result of a compressive stress in the matrix caused by the cubic-to-monoclinic transformation in the ZrO_2. (auth)

1074 SILICON YTTRIUM OXYNITRIDES. Wills, R. R. (Air Force Aerospace Research Labs., Dayton, OH). J. Amer. Ceram. Soc.; 57: No. 10, 459(Oct 1974).

Production of refractory grain boundary phases in Si_3N_4 by addition of Y_2O_3 was studied. Results indicate that the role of the Y_2O_3 additive in the hot-pressing of Si_3N_4 is that the Y_2O_3 initially reacts at the grain boundaries to form the lower-melting $Si_3N_4 \cdot 3Y_2O_3$, which then acts as a densification aid. Further reaction transforms the grain-boundary phase to the more refractory $Si_3N_4 \cdot Y_2O_3$, which is responsible for the improved high-temperature properties of the resulting Si_3N_4. (JRD)

1075 BEAM HEATING OF UO_2 THIN FOILS IN AN ELECTRON MICROSCOPE. Krasevec, V. (Jozef Stefan Nuclear Inst., Ljubljana, Yugoslavia). Mater. Res. Bull.; 9: No. 10, 1353-1356(Oct 1974).

Parallel striations in thin foils of UO_2 single crystals introduced by pulse beam heating in the electron microscope were studied by electron microscopy and electron diffraction. The observations are consistent with the view that both parallel (110) surfaces of the thin foil transform during heating into sets of parallel {111} faces. (auth)

1076 FORMATION OF A HIGH-TEMPERATURE CARBIDE α-MoC_{1-x} IN SLIGHTLY ALLOYED MOLYBDENUM. Arkharov, V. I.; Drachinskii, A. S.; Pisarenko, V. A.; Samoilenko, Z. A.; Trefilov, V. I. (Donetsk Technical-Physical Inst., USSR). Fiz. Metal. Metalloved.; 37: No. 6, 1312-1314(Jun 1974). (In Russian).

The molybdenum alloys under investigation contained the following alloy elements: (1) C–0.08 wt %, Ti–0.1%, Zr–0.32%; (2) C–0.032 wt %, Ti–.02%; (3) C–0.032 wt %, Zr–.17%. The strongly deformed samples (after extrusion and forging at 1000°C, mechanical treatment and electropolishing) were subjected to rapid electroheating followed by cooling on attaining a definite temperature. Electroheating was carried out in a vacuum of 10^{-2} mm Hg std. A number of samples were annealed in a furnace at 1800, 1900, and 2000°C in a vacuum of 10^{-3} mm Hg std and in an atmosphere of argon. Needle-shaped deposits were observed on the alloy surfaces. X ray analysis of these surface deposits showed that they were α-MoC_{1-x}. (tr-SJR)

1077 REASONS FOR THE CRACKING OF PRODUCTS FROM PYROLYTIC ZIRCONIUM NITRIDE. Bol'shakov, P. P.; Ermakov, B. G.; Zhukova, V. N.; Neshpor, V. S.; Sokolov, V. V.; Trofimov, V. V. Tr. Leningrad. Politekh. Inst.; No. 331, 62-65(1973). (In Russian).

Radiographic and metallographic studies of pyrolytic ZrN deposited on graphite substrates showed the presence of an impurity phase located on the grain boundaries and in the matrix itself. These phases can form large aggregates, near which a lattice of microcracks can be observed. The residual stresses measured significantly exceed the thermal stresses and change substantially from sample to sample. It was assumed that the causes for the appearance of high residual stress and its wide dispersion are the structural inhomogeneity of the pyrolytic ZrN. (tr-auth)

1078 ABRASIVE REMOVAL OF A HARD ALLOY IN DIAMOND ELECTROCHEMICAL DRILLING. Gurvich, R. A.; Kostenetskaya, G. D. Elektron. Obrab. Mater.; No. 1, 7-8(1974). (In Russian).

Data relating to the corrosion cracking of hard alloys such as WC–CO during diamond electrochemical drilling were derived by comparing the microrelief on the surface of samples processed in this way with that of samples subjected to conventional diamond drilling. The characteristics of abrasive wear were analyzed by simulating the process in both cases at a low cutting rate. Microcracks developed on the surface of initial scratches made in the metal, and these microcracks facilitated the subsequent removal of the top layer. The merit of diamond-electrochemical machining lay in the fact that corrosion processes sharply intensified crack formation. (Metals Abstr.)

1079 ISOSTATIC PRESSING IMPROVES THE PERFORMANCE OF COLD FORMING TOOLS. Met. Metal Form.; 41: No. 1, 8-10; 12(Jan 1974).

An installation is described for the manufacture of hard metal (WC–Co alloys) by isostatic hot pressing. The resultant beneficial effects are claimed to be the reduction in the porosity of WC–Co alloys, and an improvement in the transverse rupture strengths of alloys with Co ≤ 25%. The practical applications of isostatically hot pressed hard metal are discussed. (Metals Abstr.)

1080 CRYSTALLOGRAPHIC, MAGNETIC, AND ELECTRICAL PROPERTIES OF LANTHANUM ORTHOVANADATE $LaVO_3$. Dougier, P.; Hagenmuller, P. (Univ. Bordeaux). J. Solid State Chem.; 11: No. 3, 177-183(Nov 1974). (In French).

The $LaVO_3$ perovskite has been investigated between 77 and 700°K by x-ray diffraction, magnetic susceptibility, electrical conductivity, and thermoelectric power measurements. The

observed properties fit with Goodenough's localized electron model ($b < b_c$). The p-type extrinsic conductivity probably due to V^{4+} holes is well described by a thermally activated hopping mechanism of small polarons. (auth)

1081 DEPOSITION OF TITANIUM CARBIDE ON HIGH-MELTING-POINT SUPPORTS. Elyutin, V. P. Izv. Vyssh. Ucheb. Zaved., Chern. Met.; No. 1, 5-7(1974). (In Russian).

The deposition of TiC on W and Mo supports in the impulse plasma from a gaseous phase containing H, $TiCl_4$, CH_4, and C_2H_2 was investigated. The dependence of the thickness of the precipitated layer on the number of plasma impulses and the composition of the gaseous phase, as well as the microhardness, phase composition, and lattice parameters of the carbide are determined. Differences in the microhardness of TiC deposited on Mo and W are ascribed to the influence of the support material. The microhardness also depends on the composition of the gaseous phase. (Metals Abstr.)

1082 COATING MICROSPHERES WITH ZIRCONIUM CARBIDE-CARBON ALLOY. Ikawa, K.; Iwamoto, K. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). J. Nucl. Mater.; 52: No. 1, 128-130(Aug 1974).

Codeposited zirconium carbide-carbon alloy, or zirconium carballoy for short, is expected to be an improved material for coating fuel particles for use in high-temperature gas-cooled reactors. The carballoy can be formed by simultaneous vapor deposition of carbon and zirconium from hydrocarbon and zirconium halide. In order to find an appropriate process to coat fuel particles with the carballoy, the chloride process and the iodide process have been investigated so far by using alumina microspheres. Very recently Reynolds applied the chloride process to coat fuel particles with zirconium carbide. In the experiment described, the bromide process was applied to coat microspheres with the carballoy. (auth)

1083 URANIUM CARBIDE FUEL TECHNOLOGY. Gorle, F.; Coheur, L.; Timmermans, W. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). J. Nucl. Mater.; 51: No. 3, 343-353 (Jul 1974).

To evaluate the influence of oxygen contamination on the irradiation behavior of carbides, two series of pellets of high and low (4000 and 400 ppM) oxygen content were made in a UC fabrication line. In the 18 pellets of each series, the amounts of sesqui-carbides, and of vanadium or chromium, used as a stabilizing agent, were studied as variables; high and low densities were produced. For each composition, the method adapted to reach the very rigid specifications of composition and density is described. (auth)

1084 FURTHER COMMENTS ON THE MECHANISM OF CARBON SELF-DIFFUSION IN HYPERSTOICHIOMETRIC URANIUM CARBIDES. Sarian, S. (Washington Univ., Seattle (USA). Div. of Metallurgical Engineering). J. Nucl. Mater.; 51: No. 3, 354-356(Jul 1974).

Makino et al. purport to show that the diffusion of carbon in uranium carbides occurs by either an interstitial or an interstitialcy mechanism. Both mechanisms require that at least some of the excess carbon atoms occupy tetrahedral sites. There is no reason to believe this actually occurs; in fact, the available experimental evidence indicates that the carbon sub-lattice of hyperstoichiometric uranium carbides consists of C_2 groups and single carbon atoms in the octahedral positions of the B-1 (NaCl type) crystal structure; a small concentration of carbon and uranium vacancies are formed through Schottky disorder. Using this defect model, Sarian has analyzed the carbon diffusivity data obtained by a number of investigators for compositions over the entire homogeneity range of the B-1 type UC_x ($0.95 < \chi < 1.9$); these results indicate that carbon self-diffusion in hyperstoichiometric uranium carbides involves the migration of single carbon atoms from doubly occupied, to singly occupied, octahedral sites. (auth)

1085 THE EFFECT OF Fe, Ni AND W IMPURITIES ON URANIUM DIFFUSION IN URANIUM MONOCARBIDE. Matzke, H. (Commission of the European Communities, Karlsruhe (F. R. Germany). European Inst. for Transuranium Elements). J. Nucl. Mater.; 52: No. 1, 85-88(Aug 1974).

The self-diffusion of uranium with ^{233}U as tracer was measured in stoichiometric UC which was doped with Fe, Ni, or W impurities. The impurities were added by flash evaporation on the UC and subsequent diffusion into the UC. Uranium diffusion was increased in the doped samples as compared to undoped UC at all temperatures studied (1380 to 2200°C). The increase was most pronounced (more than a factor of 100) at low temperatures. Simultaneously, pronounced grain-boundary penetration was observed at low temperatures, possibly due to eutectic formation at the grain boundaries. The ratio of grain boundary to lattice diffusion coefficients at 1380°C was of the order of 3×10^4. The present data serve to explain some of the scatter of the literature data and correlate well with the known increased rate of sintering of Ni-doped UC. (auth)

1086 STUDY OF THE VAPORIZATION OF Ba FROM UO_2 NUCLEAR FUEL PARTICLES BY HIGH-TEMPERATURE MASS SPECTROMETRY. Hilpert, K. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralinstitut fuer Analytische Chemie); Foerthmann, R.; Nickel, H. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorwerkstoffe und Heisse Zellen). J. Nucl. Mater.; 52: No. 1, 89-94(Aug 1974).

In connection with improving the retention of solid fission products in gas-cooled high-temperature reactor fuels, the vaporization of Ba from UO_2 model nuclear fuel particles with and without a pyrocarbon coating was studied by high-temperature mass spectrometry using a Knudsen cell. The UO_2 kernels of the particles were doped with BaO. In addition, some of them contained Al_2O_3. Whereas BaO mainly evaporated from the surface of the kernels as BaO, only Ba could be observed over the coated particles. Moreover, the BaO vapor pressure over kernels with and without the addition of Al_2O_3 was determined. From this it was determined that the BaO vapor pressure could be diminished by approximately two orders of magnitude by the admixture of Al_2O_3. Finally it was proved that the diminution of the BaO vapor pressure was caused by the formation of the compound $BaAl_2O_4$. (auth)

1087 UO_2 SOLIDIFICATION PHENOMENA ASSOCIATED WITH RAPID COOLING IN LIQUID SODIUM. Cronenberg, A. W.; Fauske, H. K. (Argonne National Lab., Ill. (USA)). J. Nucl. Mater.; 52: No. 1, 24-32(Aug 1974).

An important safety aspect of fuel meltdown in a liquid-metal fast breeder reactor (LMFBR) is the fragmentation of molten UO_2 into finely divided particles when quenched in sodium coolant, with subsequent coolant vaporization. In order to analyze the mechanics of such fragmentation, a knowledge of the physical state of the UO_2 surface within the breakup period must be known. To accomplish this, the kinetics of crystal formation and growth are investigated and compared with the heat transfer controlled solidification rate to determine whether or not the surface of a UO_2 droplet can remain molten if contact is established during quenching in sodium coolant. Results indicate that although the initial heat transfer rate for perfectly wetted UO_2 is quite rapid, the crystallization process is approximately an order of magnitude greater, with the UO_2-Na contact temperature well below the temperature for homogeneous solidification. Thus, it can be concluded that the freezing of UO_2 in sodium is heat transfer limited such that any fragmentation analysis should account for surface solidification. (auth)

1088 COMPOUNDS OF THE TRANSURANIUM ELEMENTS. P. 1. Oxides, Nitrides, and Carbides. Koch, G. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Heisse Chemie). Chem.-Ztg., Chem. App.; 97: No. 10, 539-543(Oct 1973). (In German).

3 figs.; 3 tabs.; 32 refs.

Compounds of the transuranium elements with non-metals are reviewed. In particular, binary and pseudo-binary compounds are discussed. The information presented here deals with the oxides, carbides, and nitrides, which are of particular technical importance. (auth)

1089 MoO_3-WO_3 AND Li_2O-MoO_3-WO_3 SYSTEMS. Gloeikler, D.; Jeannot, F.; Gleitzer, C. (CNRS, Nancy Cedex, France). pp 23-24 of Chemistry and Uses of Molybdenum. Mitchell, P. C. H. (ed.). London; Climax Molybdenum Co. Ltd. (1973).

From 1st international conference on the chemistry and uses of molybdenum; Reading, UK (17 Sep 1973). See CONF-7309118-.

The oxidation at moderate temperatures of solid solutions of the dioxides [Mo, W]O_2 allows a determination of the system MoO_3-WO_3. A monophasic region, $Mo_{1-x}W_xO_3$ [0,35 < × < 0,85], appears with two polymorphic modifications. In the system LiO_2-MoO_3-WO_3 the phase relationships between molybdates and tungstates are established. An unexpected trimolybdotungstate $Li_2[Mo_{1-x}W_x]_3O_{10}$ [0,1 < × < 0,8] is obtained in spite of the non-existence of the pure trimetallates. Several miscibilities between molybdates and tungstates are observed. (auth)

1090 Nb-Mg-O SYSTEM. Borroni Grassi, G. Atti Accad. Sci. Torino. I. Cl. Sci. Fis., Mat. Natur.; 108: No. 1, 71-81 (1974). (In Italian).

The equilibrium relations among the solid phases appearing in zones of the ternary system MgO-NbO-Nb_2O_5 including the compounds NbO_2, Nb_2O_5, and $MgNb_2O_6$ were studied. The studies were made by radiographic analysis of mixtures of MgO, NbO_2 and

Nb_2O_5 sintered under vacuum at 1250°C. In addition to the narrow ternary monophase zone corresponding to a solid solution of the Nb_2O_5 type, a single complete series of mixed crystals between the $Nb_{12}O_{29}$ and $(Nb_{11.33}Mg_{0.66})O_{29}$ phases was observed. Both were characterized by the ratio O/Me = 2.417 and were assigned to the Nb_2O_5-NbO and Nb_2O_5-MgO systems respectively. The other phases (O/Nb = 2.483, 2.478 to 2.470, 2.468 to 2.462, 2.450, and 2.00) of the Nb_2O_5-NbO system form limited regions of mixed crystals. Eleven biphase zones and five triphase zones were observed. On the basis of previously obtained results and results from the present study, an hypothesis was proposed on the effect that small additions of Mg to Nb-based alloys can have on the possible formation of protective layers capable of increasing the resistance to thermal oxidation. Among the possible alloys of Nb studied, those containing 11 wt. % Mg seem to be, at temperatures below 1200°C, particularly resistant to oxidation. Lower Mg contents have little effect on the oxidation resistance. (tr-auth)

1091 ATOMIC DISPLACEMENT AND IONIZATION EFFECTS ON THE OPTICAL ABSORPTION AND STRUCTURAL PROPERTIES OF ION-IMPLANTED Al_2O_3. Arnold, G.W.; Krefft, G.B.; Norris, C.B. (Sandia Laboratories, Albuquerque, New Mexico 87115). Appl. Phys. Lett. 25: No. 10, 540-542 (15 Nov 1974).

Ion-induced lattice atom displacements in single-crystal Al_2O_3 give rise to an optical absorption band at 204 nm as well as to expansion of the implanted volume. The 204-nm absorption per unit energy into atomic processes is found to increase rapidly with decreasing incident ion mass. In contrast, light ions (H^+, D^+, He^+) show less volume expansion per unit energy into atomic processes than do heavier ions. Furthermore, the volume expansion induced by heavy ion implantation can be completely relieved by H^+-ion implantation or by ionizing electron irradiation (8.16 keV). A simple model characterizes the results. The 204-nm absorption is found to be proportional to the ion energy into electronic processes, and the expansion is proportional to the ion energy into atomic processes linearly reduced by the ion energy into electronic processes. The implications for defect production in CTR insulators are discussed. (auth)

1092 STUDY OF DISTRIBUTION OF RARE EARTHS IN α-Al_2O_3 CRYSTALS BY ACTIVATION SCANNING. Abdurakhmanova, S. R.; Zhdanov, E. A.; Lobanov, E. M. pp 256-266 of Kinetika i Mekhanizm Kristallizatsii. Sirota, N. M. (ed.). Minsk; Izdatel'stvo Nauka i Tekhnika (1973). (In Russian).

The equipment used and the results obtained in activation of Al_2O_3 crystals containing trace amounts of rare earths are described. Activation of 0.2 to 0.1 wt % of the individual rare earths added to the original raw materials in corundum crystals determined 30 to 50% of them. When a binary mixture of rare earths was used, their limiting solubilities decreased, the values varying with the pairs of rare earths used. Diagrams of the distribution of the rare earths along the crystal boundaries are shown. (MG)

1093 BIBLIOGRAPHY OF YTTRIA STABILIZED ZIRCONIA STUDIES. Aypar, A. (Nuclear Research Center, Ankara). Tech. J., Ankara Nucl. Res. Cent.; 1: No. 3, 137-152(Oct 1974).

A bibliography of more than hundred papers in the field of yttria stabilized zirconia refractory, research and technology provides a catalog of the published works so that investigators can more easily relate their work to that reported by others. The information has been arranged according to the following major classifications including preparation of yttria stabilized zirconia, stabilization, phase diagrams (crystal structure), mechanical properties (creep, thermal expansion), conductivity, physico-chemical behavior (current blackening, etching), electron paramagnetic resonance, optical properties, dielectric properties, elastic properties, and emission spectroscopy applications. In most of the papers, the properties outlined are on polycrystalline and some on single crystals of yttria stabilized zirconia. (auth)

1094 EFFECT OF THE TEMPERATURE OF PLASTIC DEFORMATION ON THE STRUCTURE AND PROPERTIES OF Be BRONZE. Smirnov, M. A.; Shteinberg, M. M.; Kareva, N. T.; Teplov, V. A.; Koryagin, Yu. D. (Chelyabinsk Polytechnic Inst., USSR). Fiz. Metal. Metalloved.; 38: No. 2, 416-421 (Aug 1974). (In Russian).

It was shown that the strongest Be bronze can be obtained by deformation in the temperature region of intense development of aging processes (300 to 350°). It was also established that Be bronzes with high-temperature plastic deformation can be used for strength. (tr-auth)

Metals and Alloys

1095 (DEU-72-17) MATERIALS FOR USE IN REACTOR TECHNOLOGY. (Vereinigte Deutsche Metallwerke A. G., Frankfurt am Main (F. R. Germany)). [nd]. 49p. (In German).

This report gives information on the most important materials and their properties which are produced by this company for nuclear technology i.e. for high-energy physics, reactors, isotope technique, fuel circulation, nuclear radiation, etc. The paper is arranged according to use (materials for nuclear reactor cores, building materials for reactors and nuclear plants, welding materials, low-temperature equipment). After many years of research and development work, zirconium alloys proved to be of particular importance in the building of reactors. (20 fig., 35 tables) (GE)

1096 HYDROGEN IN METALS. Proceedings of an International Conference on the Effects of Hydrogen on Materials Properties and Selection and Structural Design, Champion, Pennsylvania, September 23-27, 1973. Bernstein, I. M.; Thompson, A. W. (eds.). Material/Metalworking Technology Series, Number 2. Metals Park, OH; American Society for Metals (1974). 794p. (CONF-730922-).

Fifty-three papers were presented at the conference. A separate abstract was prepared for each of twenty papers selected by NSA scope. (JRD)

For abstracts of individual papers see: 1112-1130 and 1244.

Corrosion and Erosion

Refer also to abstracts 41, 50, 1072, 2348, 2353, 2554, and 2357.

1097 (AD-779057) OXIDATION AND HOT CORROSION OF Ni-Cr- AND Co-Cr-BASE ALLOYS CONTAINING RARE EARTH OXIDE DISPERSIONS. Final Report, 6 February 1973-5 February 1974. Wright, I. G.; Wilcox, B. A.; Jaffee, R. L. (Battelle Columbus Labs., Ohio (USA)). 11 Apr 1974. Contract N62269-73-C-0327. 109p. NTIS $4.50.

The objectives of the program were to determine the effects of rare earth oxide dispersions on the oxidation and hot corrosion of Ni-Cr- and Co-Cr-base alloys, with emphasis on alumina scale-forming Co-base alloys. The results generated are intended to provide a better understanding of the compositional requirements of oxidation-resistant and hot corrosion-resistant superalloys for high-temperature service in severe environments. (GRA)

1098 (AD-779065) BASIC MECHANISMS PROVIDING OXIDATION RESISTANCE IN STRUCTURAL METALS AT HIGH TEMPERATURES. Final Report, 21 December 1972-20 December 1973. Rosa, C. J. (Cincinnati Univ., Ohio (USA). Dept. of Materials Science and Metallurgical Engineering). Jan 1974. Contract N62269-73-C-0520. 117p. (NASC-0520-4). NTIS $4.50.

Oxidation characteristics of Ti-4.32 wt % Nb and Ti-4.37 wt % Ta exposed to pure oxygen or air are reported for the temperature range 982 to 1200°C. The oxidation kinetics can best be described by either an initial parabolic or cubic rate which is followed by consecutive parabolic relationships. It is shown that 64% and 75% of the total amount of oxygen is dissolved in the metal matrix of the Ti-4.37 Ta alloy and 58% and 63% dissolves in the matrix of the Ti-4.32 Nb alloy during oxidation at 1000 and 1200°C, respectively. X-ray diffraction studies reveal that the only oxide phases present are solid solutions of $TiO_2-Nb_2O_5$ or $TiO_2-Ta_2O_5$ formed during oxidation in oxygen. Oxidation in air leads to the formation of delta-tin and/or epsilon-tin at the metal/oxide interface, depending on the oxidation temperature. Hardness profiles and oxidation rate constants were used to calculate the diffusion coefficient of oxygen in both alloys. Electromotive force measurements were made. (GRA)

1099 (AD-779414) STRESS CORROSION CRACKING SUSCEPTIBILITY OF BETA TITANIUM ALLOY 38-6-44: CANDIDATE ALLOY FOR SCOUT TORSION BAR. Final Report. Czyrklis, W. F.; Levy, M. (Army Materials and Mechanics Research Center, Watertown, Mass. (USA)). Apr 1974. 12p. (AMMRC-TR-74-10). NTIS $3.00.

The threshold stress intensities for stress corrosion crack propagation in beta titanium alloy 38-6-44, Ti-3Al-8V-6Cr-4Mo-4Zr, has been determined in salt water and methanolic solutions. The alloy was immune to stress corrosion cracking in aqueous sodium chloride solutions (marine environment). However, in methanolic solutions, the alloy was very susceptible to scc. This marked susceptibility in methanolic solutions can be mitigated by the addition of sodium nitrate as an inhibitor. Crack extension in the alloy was transgranular and failure occurred by brittle quasicleavage in methanolic solutions. (GRA)

1100 (JAERI-M-5683) CORROSION OF AUSTENITIC STAINLESS STEELS IN LIQUID LITHIUM. 1. Nihei, I.; Sumiya, I.; Fukaya, Y.; Yamazaki, Y. (Japan Atomic Energy Research Inst., Tokyo). May 1974. 32p. (In Japanese). NTIS (U. S. Sales Only).

A series of tests on fusion reactor materials is in progress. Preliminary lithium corrosion tests on austenitic stainless steels are shown. Specimens were tested at temperatures up to 600°C in a natural lithium circulation corrosion testing apparatus. The testing conditions are: apparatus material, 304 SS; test specimens, 304 SS, and 316 SS; maximum temperatures, 400, 500, and 600°C; lithium temperature difference, 100°C; lithium flow rate, 200 cc/min; and testing period, 1100 h. The following results have been obtained: (1) The corrosion is general corrosion. (2) The corrosion rate at 600°C is 11.6 μ/year for 304 SS and 11.9 μ/year for 316 SS. (JA)

1101 FEATURES OF THE STRESS CORROSION OF ALUMINUM ALLOYS. van Leeuwen, H. P. Polytech. Tijdschr., Procestech.; 27: No. 9, 287-297(1972).

A review is presented dealing with problems associated with various methods for testing Al–Cu–Mg and Al–Zn–Mg alloys for susceptibility to stress corrosion cracking and with heat treatment for reducing cracking. Theories relating to the susceptibility of alloy microstructure components are discussed and the influence of Si, Cr, Mn, V, Zn, Ti and other elements on the properties of Al–Zn–Mg alloys is analyzed. (57 references) (Corros. Abstr.)

1102 ATTACK UPON THE CLADDING OF OXIDE FUEL PINS BY FUEL AND FISSION PRODUCTS. Goetzmann, O.; Hofmann, P.; Thuemmler, F. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). J. Nucl. Mater.; 52: No. 1, 33-50(Aug 1974).

In parallel with post-irradiation examinations, a comprehensive out-of-pile experimental program was performed to determine the most important fission product reactions with four austenitic stainless steels at different oxygen potentials. Single as well as groups of fission products (simulated burn-up systems) were used. Only the elements cesium, iodine and tellurium cause dangerous reactions with the cladding of an oxide fuel pin. The others are either not reactive or produced in such small quantities that their attack on the cladding is insignificant. Molybdenum is often found in the reaction zone of an irradiated oxide pin. However, according to out-of-pile results it does not look as if molybdenum is a dangerous fission product. A decisive factor for the occurrence of reactions with the cladding is the oxygen potential in the fuel pin. As long as the O/M ratio of the fuel is markedly below 2.00, there are no dangerous reactions, neither with cesium nor with tellurium and iodine. The post-irradiation investigations (burn-up 1 to 10 at. %) show that the cladding attack below 750°C is most dependent on the inner wall temperature. Other factors, including fuel density, rod power and burn-up, seem to play a minor role. A noticeable reduction of the cladding attack was observed when the initial O/M ratio of the fuel was less than 1.98. A kinetic evaluation of some of the reactions observed in the out-of-pile tests has been attempted. At temperatures above 700°C, the influence of temperature decreases markedly and the fission product concentration in the fuel becomes more important. There are indications that this also holds true for in-pile conditions. (auth)

1103 A MECHANISM FOR IN-REACTOR OXIDATION OF ZIRCONIUM ALLOYS FROM OXIDE ELECTRICAL CHARACTERISTICS. III. Zr-2.5 wt % Nb. Shirvington, P. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights. Materials Div.). J. Nucl. Mater.; 52: No. 1, 13-23(Aug 1974).

A molten nitrate/nitrite eutectic was used for studying the electrical characteristics of oxides on heat-treated Zr–2.5 wt % Nb in two conditions: quenched from 850°C or quenched, cold-worked and aged at 500°C. Oxides were grown in either water or steam, with or without oxygen, out-of- or in-reactor (fast flux 1.5×10^{13} n cm^{-2} s^{-1}). Tafel analysis of current-voltage curves yielded oxide growth rates that were generally in reasonable agreement with weight gain data. Radiation suppressed the oxidation rate and the ionic and electronic oxide conductances, by inducing oxide recrystallization and precipitating niobium from solid solution in the metal. The latter was not a factor for quenched, cold-worked and aged material for which the most important corrosion resistant property was that the oxide did not become highly water permeable in reactor environments containing free oxygen. In this the behavior of the alloy was in sharp contrast to that of Zircaloy-2 and other alloys. (auth)

1104 A MECHANISM FOR IN-REACTOR OXIDATION OF ZIRCONIUM ALLOYS FROM OXIDE ELECTRICAL CHARACTERISTICS. II. Crystal-Bar Zirconium and Zr–1.2 wt % Cr–0.08 wt % Fe. Shirvington, P. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights. Materials Div.). J. Nucl. Mater.; 52: No. 1, 1-12(Aug 1974).

A molten nitrate/nitrite eutectic was used for studying the electrical characteristics of irradiated oxides on crystal-bar zirconium and Zr–1.2 wt % Cr–0.08 wt % Fe (and unirradiated controls) grown under conditions producing accelerated oxidation at 295°C. Oxygenated water in a region of fast neutron flux (1.5×10^{13} n cm^{-2} s^{-1}) or oxygenated water accompanied by fluoride contamination of specimens were two such conditions. Tafel analysis of current-voltage curves yielded oxide growth rates which were in reasonable agreement with weight-gain data. Results indicated that accelerated oxide growth was usually accompanied by the occurrence of water permeability, which thereby shortened the pathways for solid-state oxygen ion diffusion through the oxides. Such oxides were found to contain up to 3 wt % water. Thin accelerated-growth films were not water permeable, but exhibited enhanced conductivity, suggesting that pore formation may be gradual and preceded by an increase in the ease of solid state oxygen ion diffusion in the oxide. Possible mechanisms of pore formation are discussed. Electronic conduction, which most likely occurs through intermetallic precipitates and other flaws, was relatively unaffected by radiation. (auth)

1105 CORROSION BEHAVIOUR OF NEW Zr ALLOYS. Tolksdorf, E. (Danish Atomic Energy Commission, Risoe. Research Establishment). J. Nucl. Mater.; 51: No. 3, 330-336(Jul 1974).

Corrosion studies indicate that the most promising replacements for Zircaloy-2 are Zr–Cr–Fe, Zr–V–Fe and probably Zr–Nb–Ta, provided they are in their optimized condition. These alloys are conventionally manufactured alloys. An internally oxidized Zr–MgO alloy is even superior, from the corrosion and hydrogen uptake points of view, to the above-mentioned alloys. This alloy is of particular interest because the addition of MgO leads to no neutron penalty and the dispersion-strengthening entails the possibility of tailoring an alloy with the desired mechanical properties. (auth)

1106 SURFACE SEGREGATION AND INTERACTION OF OXYGEN AND NITROGEN WITH ZIRCONIUM IN Nb–1% Zr ALLOY. Joshi, A.; Varma, M. N.; Strongin, M. Met. Trans.; 5: No. 4, 861-863(Apr 1974).

Surface segregation and interaction of Zr, O, and N were studied in a Nb–1% Zr alloy utilizing Auger electron spectroscopy. Segregation of 0 to the surface occurs at temperatures as low as 500°C with the maximum occurring around 1300°C. Oxygen at the surface appears to be in two states, of which one corresponds to a strongly bound state with Zr. Oxygen in this state, like Zr, does not redistribute into the bulk at high temperatures. Segregation of N to surfaces is observed in samples cooled from temperatures >1000°C. The segregation of Zr, O, and N is all limited to a few monolayers near the surface. When heated above 1500°C, O and Zr are removed from the sample probably in the form of oxides of Zr and Nb. (Metals Abstr.)

1107 ANODIZATION OF SEVERAL RARE EARTH METALS IN SODIUM SILICATE SOLUTIONS. Gruss, L.; Mackus, T. (Frankford Arsenal, Philadelphia). J. Electrochem. Soc.; 121: No. 11, 1402-1405(Nov 1974).

The rare earth metals, e.g., Sm, Gd, Dy, Ho, Er, and Yb including Y, were anodized in a 0.1N solution of reagent grade sodium metasilicate. A current density of 0.16 A/cm^2 was employed in all reactions. The reaction cell was thermostated at 14.5° ± 0.5°C. Dielectric breakdown (sparking) was observed with all of the metal-electrolyte combinations investigated. The anodic spark reaction process produced coatings the components of which were derived from the anion constituent of the electrolyte. Orthosilicate coatings were produced on samarium and gadolinium metals and mixtures of orthosilicate and a distorted sesquioxide coating were produced on yttrium, dysprosium, holmium, erbium, and ytterbium metals. Powder x-ray diffraction techniques were utilized to identify the anodic spark reaction products. Diffuse reflectance spectra between 200 and 700 mμ were also obtained for the anodic spark products. The reflectance spectra confirmed the results of the x-ray diffraction study that single compounds exist in the anodic products for samarium and gadolinium metals and mixtures exist in the anodic products of yttrium, dysprosium, holmium, erbium, and ytterbium metals when these metals were anodized in sodium silicate solutions. (auth)

1108 CORROSION PHENOMENA FOLLOWING A SODIUM–WATER MICROREACTION IN A CRACK CROSSING THE WALL OF A FAST REACTOR STEAM GENERATOR TUBE. Donati, J. R.; Grand, M.; Lecante, A.; Spiteri, P. (Electricite de France, Ecuelles). pp 267-270 of Fifth European Congress on Corrosion, Paris; Federation Europeenne de la Corrosion ([nd]). (In French)

From 5th European congress on corrosion; Paris, France (24 Sep 1973).

Test pieces in the form of tubular sections of ferritic or austenitic steel having fatigue cracks running across the wall were tested in two sodium-water loops simulating all the conditions of a steam generator except those of heat transfer. Water or steam was circulated inside these tubes which were immersed in sodium. In the case of cracked ferritic steel tubes (steel 10CD 9-10) with leak rates ranging from 10^{-3} to 10^{-1} l μsec, the crack hollows out on the sodium side as a result of a rapid oxidation mechanism, a crater having an erosion shaped profile being formed. In the case of cracked austenitic steel tubes (steel Z6CNT 18-10) with leak rates of the same order, the products of the sodium-water reaction lead rapidly to an intergranular cracking of the metal. (FR)

1109 BEHAVIOR OF FERRITIC STEELS IN CIRCULATING SODIUM. Sannier, J.; Leclercq, D.; Konovaltschikoff, O.; Dixmier, J. (CEN, Fontenay-aux-Roses, France). pp 271-274 of Fifth European Congress on Corrosion. Paris; Federation Europeenne de la Corrosion ([nd]). (In French)

From 5th European congress on corrosion; Paris, France (24 Sep 1973).

Behavior of various ferritic steels (Cr contents from 2.5 to 9%) in circulating liquid sodium at 475 to 550°C was studied. When the Cr content is 2.25% and no carbon stabilizing elements are present, decarburizing is observed only at temperatures in excess of 500°C. Good decarburization resistance (up to 550°C) is obtained for steels having a 2.25% chromium content and carbon stabilizing elements, and for 5% chromium steels. (FR)

1110 STUDY OF ARGON PURITY INFLUENCE ON THE GAS SATURATION OF HEATED METAL. Grushevaya, T. F.; Palashenko, V. I.; Levchenko, L. F.; Maergoiz, I. I.; Makhtinger, E. Ya. Stal; No. 11, 1029(Sep 1973). (In Russian).

Tank argon, grade A (99.95% pure), is not suitable for use as a protective medium in the heating of molybdenum tube processing since with its 0.004% O_2 it causes surface oxidation. The O_2 and N_2 diffuse to a depth of 1.5 mm. With a high heating rate, only the surface is oxidized (0.5 mm). When heated in a vacuum of 10^{-4} mm Hg, the surface stays clean but becomes very grainy. After being cleaned, the N_2 content decreases from 0.04 to 0.001% and O_2 from 0.004 to 0.001% and the dew point to minus 60-62°C. When heated in this argon to 2000°C, the surface stays clean and the plasticity increases. (tr-auth)

1111 CORROSION OF Z2CN18-10 STEEL BY LIQUID SODIUM AT 700°C. Bacque, P.; Lafon, A.; Sermet, E.; Champeix, L. (CEN de Cadarache, Saint-Paul-les-Durance, France). pp 263-265 of Fifth European Congress on Corrosion. Paris; Federation Europeenne de la Corrosion ([nd]). (In French)

From 5th European congress on corrosion; Paris, France (24 Sep 1973).

When austenitic steels are used for the cladding or structural parts of fast reactors, they are exposed to very special conditions. Dynamic, high-temperature liquid sodium tests were performed in order to study the behavior of these steels. A description is given of the testing circuits and operating conditions. Results of both destructive (Castaing micropobe) and nondestructive (x-ray diffraction) tests are presented. Results suggest that the effect of sodium is to produce a selective diffusion of elements from the alloy towards the sodium. This process begins at the grain boundaries and then spreads to the grains themselves, the chromium carbides becoming dissociated. The chromium (an alphagenic element) released in this way together with the depletion in nickel, carbon, and gammagenic elements tends to favor the creation and stability of a ferritic surface structure. (FR)

1112 RESISTANCE OF SELECTED HIGH STRENGTH ALLOYS TO EMBRITTLEMENT BY A HYDROGEN ENVIRONMENT. Benson, R. B. Jr. (North Carolina State Univ., Raleigh). pp 183-197 of Hydrogen in Metals. Bernstein, I. M. (ed.). Metals Park, OH; American Society for Metals (1974).

From international conference on hydrogen in metals: effect on metal properties, selection, and design; Champion, Pennsylvania, USA (23 Sep 1973). See CONF-730922-.

High strength alloys with yield strength levels of the order of 200 ksi can be produced by cold working fcc alloys that are unstable with respect to strain induced α'-bcc martensite, ϵ-hcp martensite and fcc mechanical twins. The effect of a hydrogen environment at ambient temperature on the fracture behavior of the alloys selected for this investigation was studied using precracked single edge notch specimens. Iron-manganese base alloys and a cobalt-nickel base alloy which were strengthened by ϵ martensite and/or fcc mechanical twins did not appear to be embrittled when stressed in a one atmosphere hydrogen environment. The cobalt-nickel base alloy at a yield strength level of 300 ksi, which was produced by heat treatment after cold working, also did not appear to be embrittled when stressed in a one atmosphere hydrogen environment. The effect of a high pressure hydrogen environment on the fracture behavior of several of these alloys is discussed. The initial microstructures of each alloy in each metallurgical state were determined using primarily transmission electron microscopy techniques in conjunction with x-ray analysis. The strengthening structures in each alloy are reviewed and discussed. By considering both alloy chemistry and metallurgical microstructure, high strength alloys can be produced that have some resistance to embrittlement by a hydrogen environment under certain conditions. (auth)

1113 INFLUENCE OF TWO MODES OF LOADING ON THE STRESS CORROSION SUSCEPTIBILITY OF Ti-8Al-1Mo-1V ALLOY IN VARIOUS CHLORIDE-CONTAINING ENVIRONMENTS. Green, J. A. S.; Hayden, H. W. (Martin Marietta Labs., Baltimore). pp 235-246 of Hydrogen in Metals. Bernstein, I. M. (ed.). Metals Park, OH; American Society for Metals (1974).

From international conference on hydrogen in metals: effect on metal properties, selection, and design; Champion, Pennsylvania, USA (23 Sep 1973). See CONF-730922-.

Controversy exists concerning the environmental factors associated with the stress-corrosion cracking (SCC) of high strength titanium alloys exposed to chloride solutions. Some workers consider that the critical, failure-inducing, species are chloride ions and that failure occurs by dissolution at a rate governed by the transport of these ions to the crack tip. Others suggest that cracking results from some form of hydrogen embrittlement. The susceptibility to cracking of Ti-8Al-1Mo-1V exposed to aqueous chlorides was examined to resolve this issue. A comparison of the failure characteristics of the alloy under both mode I loading (tensile) and mode III loading (torsional) has been undertaken. This comparison was chosen because if, in fact, failure is due to hydrogen embrittlement, then the material should be less susceptible under mode III loading, since there is little or no component of hydrostatic stress to cause the concentration of hydrogen in the crack tip region. On the other hand, if cracking is due to chloride ions it should occur under both loading modes. The results indicated that the alloy is not susceptible to SCC when subject to mode III loading. This result, which is supported by the appearance of the various fracture surfaces, suggests that the failure mode of titanium alloys in aqueous solutions is some form of hydrogen embrittlement. (auth)

1114 EFFECTS OF HYDROGEN ON THE MECHANICAL PROPERTIES AND FRACTURE OF Zr AND REFRACTORY METALS. Birnbaum, H. K.; Grossbeck, M.; Gahr, S. (Univ. of Illinois, Urbana). pp 303-323 of Hydrogen in Metals. Bernstein, I. M. (ed.). Metals Park, OH; American Society for Metals (1974).

From international conference on hydrogen in metals: effect on metal properties, selection, and design; Champion, Pennsylvania, USA (23 Sep 1973). See CONF-730922-.

The effect of hydrogen on the mechanical properties of zirconium and the refractory metals is reviewed with particular attention paid to the effects on fracture and ductility. The various mechanisms proposed for the hydrogen embrittlement of these metals are also reviewed. Both the effects of hydrogen in solution and in the surrounding gas phase is considered. New results on the embrittlement of Nb and Nb-N alloys obtained using a variety of experimental techniques are presented and discussed relative to the generic embrittlement phenomena in these metals. The relation of the crack propagation mechanism to stress and temperature induced phase changes is discussed and a model of hydrogen embrittlement is offered. (auth)

1115 EMBRITTLEMENT OF URANIUM AND U-0.8 Ti ALLOY BY HYDROGEN AND WATER. Johnson, H. R.; Dini, J. W.; Zehr, S. W. (Sandia Labs., Livermore, CA). pp 325-343 of Hydrogen in Metals. Bernstein, I. M. (ed.). Metals Park, OH; American Society for Metals (1974).

From international conference on hydrogen in metals: effects on metal properties, selection, and design; Champion, Pennsylvania, USA (23 Sep 1973). See CONF-730922-.

Hydrogen can be introduced into uranium and uranium alloys from salt bath heating, from etching and electroplating and/or from corrosion. Only a few parts per million of hydrogen picked up as a result of salt bath annealing of uranium severely reduces its elongation. In the case of etching and electroplating, any hydrogen pickup is concentrated at the surface and does not degrade tensile properties. Very little information is available on the influence of corrosion on the tensile properties. However, some data are presented showing hydrogen generation for coated and uncoated specimens sealed in moist air. In regards to corrosion in solution, embrittlement only occurs over the pH range of 5 to 10 leading to the conclusion that the embrittlement of uranium by hydrogen and water proceeds by different mechanisms. Ductility and tensile strength of uranium and U-Ti alloy are dependent

on the testing environment and the data for both parameters decrease in the order: vacuum > air > water. (auth)

1116 STRESS INDUCED MOVEMENT OF HYDROGEN IN ZIRCONIUM ALLOYS. Ells, C. E. (Chalk River Nuclear Labs., Ont.); Simpson, C. J. pp 345-360 of Hydrogen in Metals. Bernstein, I. M. (ed.). Metals Park, OH; American Society for Metals (1974).

From international conference on hydrogen in metals: effect on metal properties, selection, and design; Champion, Pennsylvania, USA (23 Sep 1973). See CONF-730922-.

A largely computational study has been conducted to examine the mechanism of stress induced movement of hydrogen in zirconium. Techniques for dealing with motion in a stress gradient are still under active discussion in the literature. If the stress field in the metal is uniform but anisotropic, then reorientation of hydride is predicted. A uniaxial tensile stress orients the hydride platelets with their normals parallel to the tensile axis. This reorientation appears to proceed slowly, relative to the times normally used in cooling specimens in the laboratory from 673°K to room temperature. Although most stress orientation of hydride reported in the literature is an effect of stress/nucleation rather than stress/growth, some experimental results on stress orientation must be attributed to growth. With all hydrogen in solid solution, the effect of stress on hydrogen distribution is thought to be negligibly small. It is suggested that much of the reorientation under stress during thermal cycling is due to stress oriented growth. (auth)

1117 HYDROGEN DISTRIBUTION IN ZIRCONIUM SHEATHING OF NUCLEAR REACTOR FUELS. Sawatzky, A. (Atomic Energy of Canada Ltd., Pinawa, Minitoba). pp 361-370 of Hydrogen in Metals. Bernstein, I. M. (ed.). Metals Park, OH; American Society for Metals (1974).

From international conference on hydrogen in metals: effect on metal properties, selection, and design; Champion, Pennsylvania, USA (23 Sep 1973). See CONF-730922-.

Some test fuel elements in WR1, an organic cooled nuclear reactor, consisted of UC pellets inserted into tubular zirconium sheaths with gas plenums about 1 cm long at the upper ends. After 200 days operation several sheaths defected over the plenum. Metallographic examination showed heavy hydriding in this region whereas the sheath over the fuel adjacent to the plenum was unhydrided. The sheath temperature over the fuel was hotter than that over the plenum so that thermotransport probably caused hydrogen to diffuse from the hotter to the colder region. A model based on this assumption gave the result that a 5 to 12 cm length of sheathing next to the plenum/fuel interface would be free of hydride; the hydrogen picked up from the coolant over this region diffusing to the plenum. A mathematical expression was derived which enables the sheath temperature and the hydriding rate to be calculated knowing the length of the unhydrided region and the hydrogen distribution over it. Results obtained were in excellent agreement with those using other methods. The regular fuel for WR1, which has zirconium wire spot-welded to the sheathing to serve as hydride sinks, has not experienced defecting of the plenum. The mathematical analysis, extended to this case, showed that the plenum should not experience excessive hydriding during the fuel lifetime. (auth)

1118 DEFORMATION AND FRACTURE OF HYDRIDED HAFNIUM. Straw, R. L.; Stoloff, N. S. (Caterpillar Tractor Co., Peoria, IL). pp 371-381 of Hydrogen in Metals. Bernstein, I. M. (ed.). Metals Park, OH; American Society for Metals (1974).

From international conference on hydrogen in metals: effect on metal properties, selection, and design; Champion, Pennsylvania, USA (23 Sep 1973). See CONF-730922-.

The effects of hydrides on the tensile deformation and fracture behavior of reactor grade hafnium between 4.2 and 298°K have been examined. Hydride habit planes and operative slip planes were determined. A marked increase in room temperature yield strength with hydrogen was noted in quenched alloys containing up to 4% hydrogen. Higher hydrogen contents produced no additional strengthening. At lower test temperatures the plateau in strengthening was reached at progressively lower solute contents. Cross slip of prismatic screw dislocations to the basal plane and past the basal hydride precipitates was shown to be responsible for the yielding plateau. Cross slip in hafnium can be suppressed by oxygen additions, thereby eliminating the plateau. Cleavage along the basal plane has been noted in hafnium tested at 4.2 and 13°K. Curved cracks with indeterminate crystallographic indices predominate at these temperatures, suggesting that cleavage occurs on more than one plane. Alloying additions, microstructure, and test variables affect the incidence of cleavage in hafnium. An estimate of the respective importance of each of these variables was made by modifying the Cottrell-Petch fracture theory. (auth)

1119 ROLE OF Hf AND Zr IN THE HYDROGEN EMBRITTLEMENT OF Ta AND Cb ALLOYS. Stephens, J. R. (Lewis Research Center, Cleveland). pp 383-392 of Hydrogen in Metals. Bernstein, I. M. (ed.). Metals Park, OH; American Society for Metals (1974).

From international conference on hydrogen in metals: effect on metal properties, selection, and design; Champion, Pennsylvania, USA (23 Sep 1973). See CONF-730922-.

Alloys of Ta and Nb are used as containment material for alkali liquid metals. Oxygen contamination concentrated at grain boundaries in such alloys as Ta-10W results in severe corrosion due to preferential attack of the high oxygen content regions by alkali metals. To circumvent this corrosion problem, alloys containing reactive elements such as Hf or Zr are employed. The reactive elements serve to getter the oxygen and it has been shown for a Ta alloy, T-111 (Ta-8W-2Hf), that corrosion was essentially nil after aging for several thousand hours in an alkali metal environment. However, recent results have shown that this long term aging of T-111 increases its sensitivity to hydrogen embrittlement during subsequent room temperature handling and testing in the presence of moist air. Based on electron microprobe, scanning electron microscopy, and x-ray diffraction results, it is concluded that Hf segregation at grain boundaries during aging is responsible for the increased sensitivity to hydrogen embrittlement. The effect of varying the Hf and W contents of T-111 on the hydrogen embrittlement sensitivity of aged material is described. The role of a similar reactive element, Zr, on the hydrogen embrittlement of Nb-1Zr is compared with results on tantalum base alloys. (auth)

1120 EFFECT OF HYDROGEN ON TITANIUM AND ITS ALLOYS. Paton, N. E.; Williams, J. C. (Rockwell International, Thousand Oaks, CA). pp 409-432 of Hydrogen in Metals. Bernstein, I. M. (ed.). Metals Park, OH; American Society for Metals (1974).

From international conference on hydrogen in metals: effect on metal properties, selection, and design; Champion, Pennsylvania, USA (23 Sep 1973). See CONF-730922-.

The detrimental effect of hydrogen on Ti and its alloys is well known and was historically the source of severe problems during the early stages of Ti production. Most of these early difficulties have been surmounted by attention to sources of hydrogen pickup during melting, rolling, and pickling, resulting in Ti mill products which have acceptably low residual levels of H. There are instances, however, where even low levels (~100 ppM) of H can be detrimental to properties. Thus attention to potential problems involving H embrittlement of Ti alloys is still an important topic. The solubility of H in Ti and the effect of alloying additions on solubility are discussed. Some of the factors which can effect solubility, such as stress and plastic deformation, are described. Hydrogen may affect the properties of Ti and its alloys either as an environment, where the average concentration of H in the metal is low, or when present in the metal either in solid solution or in the form of hydrides. Emphasis is placed on the effects of hydrogen when present in α, β and $\alpha + \beta$ alloys. The influence of hydrogen on tensile properties, slow crack growth, and fracture toughness of these alloys are discussed along with possible effects on fatigue and creep. The role of hydrogen when present in a wide range of concentrations is discussed; the influence of hydrogen levels of the order of 100 to 200 ppM on these properties is emphasized since such levels can be encountered in practice and therefore are technologically the most important. (auth)

1121 TOLERANCE OF ANNEALED 6Al-6V-2Sn TITANIUM ALLOY TO HYDROGEN EMBRITTLEMENT. Grimm, T. C.; Nowak, W. J. Jr. (McDonnell Aircraft Co., St. Louis). pp 433-443 of Hydrogen in Metals. Bernstein, I. M. (ed.). Metals Park, OH; American Society for Metals (1974).

From international conference on hydrogen in metals: effect on metal properties, selection, and design; Champion, Pennsylvania, USA (23 Sep 1973). See CONF-730922-.

An investigation was conducted to establish the tolerance of annealed Ti-6Al-6V-2Sn sheet to hydrogen embrittlement. Unnotched and 60° V-notched (K_t = 5.0) longitudinal tensile specimens were machined from 0.050 inch thick annealed Ti-6Al-6V-2Sn sheet material. The room temperature tensile properties, i.e., yield strength, ultimate tensile strength, and % elongation, of the as-received (40 ppM hydrogen) material were determined using the unnotched tensile specimens. The notched tensile specimens were cathodically charged in a 10% sulfuric acid solution to various hydrogen contents between 40 and 1000 ppM. These specimens were then used to obtain room temperature notched tensile strength

and stress-rupture data as a function of hydrogen content. The hydrogen content of each specimen was measured after testing by means of a Model EA-1 Blazers Exhalograph. Macroscopic (60×), metallographic (500×), and scanning electron microscope (2000 and 5000×) examinations were made of the fractured surfaces. Based on the results of these tests, it is concluded that room temperature embrittlement of annealed Ti–6Al–6V–2Sn begins at a hydrogen content of approximately 440 ppM and is severe above 500 ppM. (auth)

1122 AQUEOUS CHLORIDE STRESS CORROSION CRACKING OF TITANIUM: A COMPARISON WITH ENVIRONMENTAL HYDROGEN EMBRITTLEMENT. Nelson, H. G. (Ames Research Center, Moffett Field, CA). pp 445-464 of Hydrogen in Metals. Bernstein, I. M. (ed.). Metals Park, OH; American Society for Metals (1974).

From international conference on hydrogen in metals: effect on metal properties, selection, and design; Champion, Pennsylvania, USA (23 Sep 1973). See CONF-730922-.

The physical characteristics of stress corrosion cracking of titanium in an aqueous chloride environment are compared with those of embrittlement of titanium by a gaseous hydrogen environment as a contribution to the understanding of the possible role of hydrogen in the complex stress corrosion cracking process. Based on previous studies, the two forms of embrittlement are shown to be similar at low hydrogen pressures (100 N/m^2) but dissimilar at higher hydrogen pressures. In an effort to quantify this comparison, tests were conducted in an aqueous chloride solution using the same material and test techniques as had previously been employed in a gaseous hydrogen environment. The results of these tests strongly support models based on hydrogen as the embrittling species in an aqueous chloride environment. Further, it is shown that if hydrogen is the causal species, the effective hydrogen fugacity at the surface of titanium exposed to an aqueous chloride environment is equivalent to a molecular hydrogen pressure of approximately 10 N/m^2. (auth)

1123 INFLUENCE OF A SURFACE OXIDE FILM ON HYDRIDING OF TITANIUM. Caskey, G. R. Jr. (Savannah River Lab., Aiken, SC). Contract AT(07-2)-1. pp 465-474 of Hydrogen in Metals. Bernstein, I. M. (ed.). Metals Park, OH; American Society for Metals (1974).

From international conference on hydrogen in metals: effect on metal properties, selection, and design; Champion, Pennsylvania, USA (23 Sep 1973). See CONF-730922-.

Investigations of titanium and its alloys in hydrogen give evidence that a titanium dioxide film controls the reaction rate between gas and metal. Clean titanium surfaces absorb hydrogen and hydrides form readily at even room temperature. However, under ordinary circumstances titanium with a surface oxide film may show no evidence of hydride formation after five years exposure to hydrogen at temperatures as high as 100°C. The most plausible interpretation for this is that a stable oxide film of low permeability to hydrogen protects titanium from reacting. The extent of this protection depends on the integrity and permeability of the film to hydrogen. Thus, hydrogen solubility and diffusivity in the film, as well as film thickness, are important. Available mathematical analyses for absorption by a solid protected by a low permeability surface film, coupled with measured physical properties of alpha-titanium and titanium dioxide, allow estimation of the hydrogen absorption characteristics of the Ti–TiO_2 system. The predicted time for initiation of hydride formation in exposed titanium covered with a thin titanium oxide film is shown to be controlled by the magnitude and anisotropy of hydrogen diffusivity in the oxide, the texture of the titanium, and the epitaxial relation between oxide and base metal. These factors also explain in part the observed variability in hydriding susceptibility of titanium alloys. Experimental data on hydrogen absorption by sheet specimens of Ti–5Al–2 ½Sn alloy compare reasonably well with the reaction times predicted. (auth)

1124 INFLUENCE OF GASEOUS HYDROGEN ON INCONEL 718. Walter, R. J.; Chandler, W. T. (Rockwell International, Canoga Park, CA). pp 515-525 of Hydrogen in Metals. Bernstein, I. M. (ed.). Metals Park, OH; American Society for Metals (1974).

From international conference on hydrogen in metals: effect on metal properties, selection, and design; Champion, Pennsylvania, USA (23 Sep 1973). See CONF-730922-.

The embrittlement of Inconel 718 by exposure to 34.5 MN/m^2 hydrogen at ambient temperature was found to be a function of both forming operation and heat treatment. The embrittlement, as measured by reduction of notch strength in hydrogen as compared with helium, was decreased by a fine-grain size and was most severe for coarse-grained structures containing a continuous or nearly continuous precipitate tentatively identified as Ni_3Nb. Tests performed on unnotched specimens showed that the strain at which surface cracks initiate in 34.5 MN/m^2 hydrogen was approximately 3 percent and was independent of prior forming operation or heat treatment. Threshold stress intensity measurements on modified WOL specimens gave K_{TH} values for coarse-grained Inconel 718 in 34.5 MN/m^2 hydrogen as 42 $MN/m^2\sqrt{m}$ for the 1325, 1033 to 922°K heat treatment and 14 $MN/m^2\sqrt{m}$ for the 1214, 991 to 894°K heat treatment condition. (auth)

1125 HYDROGEN COMPATIBILITY OF JOINING PROCESSES FOR DISPERSION-STRENGTHENED MATERIALS. Brooks, J. A.; Thompson, A. W. (Sandia Labs., Livermore, CA). pp 527-537 of Hydrogen in Metals. Bernstein, I. M. (ed.). Metals Park, OH; American Society for Metals (1974).

From international conference on hydrogen in metals: effect on metal properties, selection, and design; Champion, Pennsylvania, USA (23 Sep 1973). See CONF-730922-.

Three joining methods were studied including electron beam (EB) welds, using two different fusion zone widths; friction welds, in which there is extensive plastic deformation but no melting occurs; and diffusion welds (also called solid-state welds or diffusion bonds). Results show that fusion (EB) welds of Td–NiCr destroyed the dispersion and were weak; diffusion welds of TD–Ni lost ductility when hydrogen charged, due to partial loss of the thoria in recrystallized grains. Friction welds of TD–NiCr were undamaged, but low ductility was observed, probably because welding parameters were not optimized. (auth)

1126 USE OF ELECTRON HIGH RESOLUTION AUTORADIOGRAPHY IN STUDYING HYDROGEN EMBRITTLEMENT. Laurent, J. P.; Lapasset, G.; Aucouturier, M.; Lacombe, P. (Paris Univ., Orsay, France). pp 559-574 of Hydrogen in Metals. Bernstein, I. M. (ed.). Metals Park, OH; American Society for Metals (1974).

From international conference on hydrogen in metals: effect on metal properties, selection, and design; Champion, Pennsylvania, USA (23 Sep 1973). See CONF-730922-.

The presence of hydrogen in metals can modify their mechanical properties in a catastrophic manner. The possible mechanisms of such embrittlement are still being discussed. Electron high resolution autoradiography techniques permits an identification of localized tritium in the metal and an analysis of its distribution in the structure. By detecting the defects that are possibly generated by hydrogen, specific mechanisms by which such defects could be formed can be considered. The study is devoted to a maraging steel (18% Ni, 8% Co, 6% Mo) and Armco iron. When hydrogen is introduced to a high degree of supersaturation in the lattice by cathodic charging from a 1N H_2SO_4 solution, it is trapped along structural defects. Most structural defects are found to be active trapping sites, namely grain boundaries, sub-grain boundaries, carbides and carbonitride interfaces, and dislocations. The maraging steel is shown to exhibit a definitive embrittlement due to the irreversible cracking of the grain boundaries on a microscopic scale. In the Armco iron, the strong influence of the carbide distribution and of the interface structure on the trapping is emphasized, though it is not possible, at the present time to describe exactly the state of the lattice around the trapping sites. (auth)

1127 LOCALIZED HYDROGEN MEASUREMENTS IN SURFACES USING THE LITHIUM NUCLEAR MICROPROBE. Adler, P. N.; Kamykowski, E. A.; Padawer, G. M. (Grumman Aerospace Corp., Bethpage, NY). pp 623-630 of Hydrogen in Metals. Bernstein, I. M. (ed.). Metals Park, OH; American Society for Metals (1974).

From international conference on hydrogen in metals: effect on metal properties, selection, and design; Champion, Pennsylvania, USA (23 Sep 1973). See CONF-730922-.

The lithium nuclear microprobe has been developed to the point where it now is a unique and reliable nondestructive technique for hydrogen concentration-depth profile analysis in surfaces. Highlights of recently completed work concerning the development of this technique are described. Calibration was performed over a concentration range from 32 ppM H to 2.64 wt % H using specially prepared NBS H-in-Ti standards and Kapton, a polyimide film. As part of this development, hydrogen surface concentrations associated with conventional cadmium and chromium plating of D6AC steel were measured. These measurements were made approximately six months after sample preparation. Very high concentrations, in excess of 200 ppM, were found after plating. The bake-out procedure following chromium plating was far more effective in reducing this concentration than the bake-out following cadmium plating. This would account for the superior mechanical behavior of high-strength steels that are chromium plated. (auth)

1128 HYDROGEN EMBRITTLEMENT OF TUNGSTEN BASE HEAVY ALLOYS. Sczerzenie, F. E. (Frankford Arsenal, Philadelphia); Rogers, H. C. pp 645-656 of Hydrogen in Metals. Bernstein, I. M. (ed.). Metals Park, OH; American Society for Metals (1974).

From international conference on hydrogen in metals: effect on metal properties, selection, and design; Champion, Pennsylvania, USA (23 Sep 1973). See CONF-730922-.

The effects of hydrogen on the mechanical properties of tungsten base heavy alloys have been demonstrated. The variables studied included composition, heat treatment, strain rate, and temperature. Alloys containing 90 weight percent tungsten and Ni-Fe or Ni-Cu were fabricated by liquid phase sintering elemental powder compacts in purified hydrogen. Tensile tests and Charpy impact tests were done on as-sintered, vacuum heat-treated and hydrogen heat-treated alloys. For all alloys, vacuum heat treatment following sintering gave the greatest improvement in tensile ductility. This effect was reversible by reheating in hydrogen. Reduction of area was measured on tensile specimens tested at strain rates from 0.002 inch/minute to 20 inch/minute. Vacuum treated specimens exhibited a decrease in reduction of area with increasing strain rate; as-sintered and hydrogen treated specimens showed an increase in reduction of area with increasing strain rate. Notched Charpy impact tests at temperatures from -196 to +300°C showed no improvement in toughness with heat treatment. Energy absorption varied with composition at higher temperatures, however. This behavior is related to slow strain rate hydrogen embrittlement in these alloys. This is thought to be a major cause of the difficulty observed in obtaining commercial alloys with high uniform mechanical properties. The microstructural aspects of this embrittlement are currently under investigation. (auth)

1129 HYDROGEN ISOTOPES IN FUSION REACTORS. Thomas, D. E. (Westinghouse Research Labs., Pittsburgh). pp 691-712 of Hydrogen in Metals. Bernstein, I. M. (ed.). Metals Park, OH; American Society for Metals (1974).

From international conference on hydrogen in metals: effect on metal properties, selection, and design; Champion, Pennsylvania, USA (23 Sep 1973). See CONF-730922-.

The essential features of fusion reactors of the magnetic confinement and inertial confinement types are reviewed from the point of view of the functional involvement of hydrogen, deuterium, and tritium in the reactor system and their possible effects on materials of construction, materials selection, and design options. The subject is of concern because of possible embrittlement of materials, possible release of tritium to the environment, and minimizing tritium inventory. In the heat removal and power conversion system the first wall and other hardware subjected to high neutron fluxes present especially difficult materials problems of which hydrogen related phenomena are a part. In the power conversion system considerable design and materials ingenuity may be required to limit tritium permeation to permissible levels. In the fuel system the unburned fuel from the plasma must be separated from the reaction products, combined with make-up fuel, and processed for return to the plasma. Tritium bred in the blanket must be collected, purified and fed in as make-up fuel. In this connection various aspects of the behavior of hydrogen isotopes in metals are brought out as influenced by reactor type and design option. (auth)

1130 HYDROGEN-STRESS CRACKING IN NATURAL-GAS-TRANSMISSION PIPELINES. Groeneveld, T. P.; Elsea, A. R. (Battelle Columbus Lab., OH). pp 727-738 of Hydrogen in Metals. Bernstein, I. M. (ed.). Metals Park, OH; American Society for Metals (1974).

From international conference on hydrogen in metals: effect on metal properties, selection, and design; Champion, Pennsylvania, USA (23 Sep 1973). See CONF-730922-.

An investigation was conducted to determine the maximum yield strength of steel, in the range from 90 to 180 ksi, that can be used for cathodically-protected, gas-transmission line pipe without encountering hydrogen-stress-cracking failures. This study showed that the rate at which a steel absorbs hydrogen from its environment is one of the most important factors that influence its sensitivity to hydrogen-stress cracking (HSC). Under severe hydrogen-charging conditions (high hydrogen-entry rates), all of the steels investigated were susceptible to HSC, and the sensitivity increased with increasing strength level. At lower entry rates, sensitivity decreased, and the lower strength materials did not crack. With the relatively low entry rates caused by cathodic protection in soils and ground waters, steels with yield strengths below about 130 ksi did not crack under sustained loads, but at higher yield strengths, HSC occurred. Thus, HSC may be a problem in cathodically protected pipelines with yield strengths above 130 ksi. Field studies were conducted in which sections of pipe, heat treated to nominal yield strengths of 110, 130, and 150 ksi were stressed to 72 percent of their yield strengths and cathodically protected in the soil at 11 test sites around the country. None of the sections failed by HSC in exposure times ranging from 5 to 8 years. (auth)

1131 EFFECT OF YTTRIUM AND THORIUM ON THE OXIDATION BEHAVIOR OF Ni-Cr-Al ALLOYS. Kumar, A.; Nasrallah, M.; Douglass, D. L. (Univ. of California, Los Angeles). Oxidation Metals; 8: No. 4, 227-263(Aug 1974).

Effects of 0.5% Y and 0.5 and 1.0% Th additions to a base alloy of Ni-10 Cr-5 Al on the oxidation behavior and mechanism was studied during oxidation in air at 1000 to 1200°C. Y decreased the oxidation kinetics slightly, whereas Th caused a slight increase. Oxide scale adherence was markedly improved by the additions. Although a number of oxides formed on Y containing alloys, quantitative x-ray diffraction showed that the rate-controlling step was diffusion of O through short-circuit paths in a thin layer of alumina that formed parabolically with time. Mixed oxides containing both Al and Y formed by the reaction of Y_2O_3 to form $YAlO_3$ initially, and $Y_3Al_5O_{12}$ (YAG) after longer times. Although the scale adherence of the Y-containing alloy was considerably better than the base alloys, spalling did occur that was attributed to the formation of the voluminous YAG particles that grew in a "mushroom"-like manner, lifting the protective scale off the substrate locally. The YAG particles formed primarily at grain boundaries in the substrate in which Y originally existed as YNi_5. This intermetallic compound reacted to form Y_2O_3, liberating metallic nickel that subsequently reacted to form NiO or $NiAl_2O_4$ spinel or both. The Y_2O_3 reacted with aluminum to ultimately form the YAG "mushrooms." Th did not form any mixed oxides; the only oxide involving Th was ThO_2, which existed as small particles at the oxide/metal interface. A beneficial effect of the thoria particles in reducing film spalling was observed. Scale spalling in the base alloy was attributed to void formation at the oxide/metal interface, the voids forming by condensation of excess vacancies from the Kirkendall effect associated with fast back-diffusion of Ni into the substrate as Al was preferentially oxidized and diffused slowly outward. The mechanism of improved scale adherence in the quaternary alloys was the elimination of voids by annihilation of the Kirkendall vacancies at vacancy sinks introduced by the noncoherent interfaces between Y and Th-containing intermetallics or oxides or both. (27 figures, 21 references) (auth)

Preparation and Fabrication

Refer also to abstract 85.

1132 (NASA-TT-F-596) TITANIUM ALLOYS FOR MODERN TECHNOLOGY. Sazhin, N. P. Mar 1970. Translated from Russian, 1968. 333p. Clrghs. Fed. Sc. and Tech. Info., Springfield, Va. $3.00.

Mainly concerned with the production and utilization of titanium in industry; chemistry and metallurgy, hydrogen embrittlement, phase transformation, influence of minor alloying elements, effect of temperature, hot bending, methods of reduction from ores, manufacturing methods for tubes and shapes, deformation parameters, welding. Data are given on a Ti-32 Mo corrosion-resistant alloy for high-temperature service in the chemical industry. Data are given on mechanical properties, metallurgical characteristics, reaction to working. A table gives corrosion weight loss data in hydrochloric acid according to various aging times and conditions after quenching from 900°C. Consideration is given also to the corrosion resistance of welded joints; joint strength and cutting methods. The book contains abstracts coded by UDC numbers, numerous tables, and graphed data as well as halftone illustrations. There is no subject index. (Corrosion Abstr.)

1133 (SLL-74-5004) ETCHING AND PLATING OF U-0.75 Ti AND U-2.3 Nb ALLOYS. Johnson, H. R.; Dini, J. W. (Sandia Labs., Livermore, Calif. (USA)). Sep 1974. Contract AT(29-1)-789. 35p. Dep. NTIS $4.75.

Etchants for preparing uranium alloys (containing 0.75 Ti or 2.3 Nb) for plating were evaluated. A solution containing iron chloride provided a uniform, relatively smooth etch for both alloys; however, for the Nb alloy, which was noticeably more difficult to etch and plate, a copper chloride etch provided the best results. An etchant containing zinc chloride and nitric acid was effective in providing extremely rough surfaces (>400 μin. center line average) and offered promise for applications in which joining by plating is a consideration. Etched and plated parts were evaluated after exposure to a water-saturated atmosphere at 94°C. Ring shear tests were used to obtain quantitative bond strength data. Scanning electron photomicrographs showed

that, typically, deposits less than 13 μm thick were porous. Data were also obtained on the stripping and replating of the U–Ti alloy. (auth)

1134 (UNI-SA-6) DEFECT EXPERIENCE IN A URANIUM–ZIRCALOY COEXTRUSION PROCESS. Tew, H. F.; Bowles, K. C. (United Nuclear Industries, Inc., Richland, Wash. (USA)). 22 Aug 1974. Contract AT(45-1)-1857. 24p. (CONF-740945-1). Dep. NTIS $4.25.

From metal working forum; Pittsburgh, Pennsylvania, USA (11 Sep 1974).

Experience in coextrusion of externally and internally Zircaloy-2-clad uranium fuel tubes for N reactor is summarized. Information is included on coextrusion process and equipment, extrusion defects, cladding unbonds, clad variations, wall variations, input material tolerances, extrusion press alignment, billet temperature, lubrication, and extrusion warp. (JRD)

1135 PREPARATION OF Ln_2MX_5 WHERE Ln = RARE EARTHS, M = Zr AND Hf, AND X = S, Se. Donohue, P. C.; Jeitschko, W. (E. I. du Pont de Nemours and Co., Wilmington, DE). Mater. Res. Bull.; 9: No. 10, 1333-1336(Oct 1974).

Ln_2MX_5 compounds were prepared by reactions of the elements in evacuated silica tubes in the presence of iodine. The compounds formed for the following combinations: When M = Zr or Hf and X = S, all rare earths except Eu and Yb. When M = Zr and X = Se, rare earths between La and Tb, except Eu. When M = Hf and X = Se, rare earths La and Ce. X-ray powder patterns were indexed on the basis of orthorhombic cells analogous to that of U_2S_5. Electrical measurements show high-resistivity semiconduction for La_2ZrS_5 and Ce_2HfS_5 but lower resistivity for Sm_2HfS_5, perhaps indicative of the presence of some Sm^{+2}. (auth)

1136 KRISTALLIZATSIYA TUGOPLAVKIKH METALLOV IZ GAZOVOI FAZY. (Crystalization of Refractory Metals from the Gaseous Phase). Ivanov, V. E.; Nechiporenko, E. P.; Krivoruchko, V. M.; Sagalovih, V. V. Moscow; Atomizdat(1974). 264p.

Methods for the production of pure metals and alloys and refractory-metal coating by precipitation from the gaseous phase participation of chemical reactions (hydrogen reduction and thermal decomposition of volatile metal compounds) were examined. The theoretical bases of the processes were discussed and particular attention was given to the development of instruments and devices from these bases. The properties of the metals obtained were described. The possibility of controlling the parameters of the process in order to obtain materials with a specific complex of physical-chemical, mechanical, and other properties were examined. Future developments of methods for precipitation from the gaseous phase and the expansion of the use of these methods were discussed. The metals considered include Mo, W, Re, Ta, Nb, Ti, Zr, Hf, and Ir. (tr-auth)

1137 EFFECT OF THE TEMPERATURE OF CONDENSATION ON THE PROPERTIES OF VACUUM CONDENSATES OF W. Yaroshevich, P. Yu.; Belomyttsev, Yu. S.; Saratovskii, L. N. Fiz. Metal. Metalloved.; 38: No. 2, 429-431(Aug 1974). (In Russian).

The texture, density, crystal lattice parameters, and microhardness of W condensates, precipitated at condensation temperatures of 600 to 1500°C, were studied. The lattice parameters were tabulated for the condensates obtained at different temperatures. A decrease in the density of the W condensates was observed for low-temperature condensation. The dependence of the grain orientation on the condensation temperature was established. (JSR)

1138 JOINING BY ELECTROPLATING. Dini, J. W.; Johnson, H. R. Metals Eng. Quart.; 14: No. 1, 6-12(Feb 1974).

A procedure for joining various materials by using electroplating is described. Parts to be joined are first given a specific taper, then they are cleaned, plated thinly with either Cu or Ni and matted. The triangular segment between the tapered edges is built up by electroplating, and the joint is machined to final tolerance. The process is done at room temp., thus eliminating the shrinkage and distortion problems associated with high-temp. joint methods. Materials that have been electrojoined include stainless steel to alloy 6061 Al, stainless steel to stainless steel, and 4340 steel to several U alloys. Various tests, such as tensile, compressive, heating and corrosion, show this technique to be a useful alternative to conventional joining processes. (Metals Abstr.)

1139 STANDARD FOR QUALIFICATION OF WELDING PROCEDURES AND WELDERS FOR PIPING AND TUBING. AWS D10.9-69. Miami, FL; American Welding Society, Inc. (1969). 80p. (ICONS-01843).

This standard provides three different levels of welding procedure and welder qualification for joining pipe, tube and components. The three levels are called Acceptance Requirements 1, 2 and 3 and are abbreviated AR-1, AR-2 and AR-3 respectively. AR-1 is the highest level of qualification, followed by AR-2 and AR-3 in that order. The differences among the three levels of qualification lie in the type of tests and the acceptance requirements for the sample welds. This document is divided into three sections; Section I covers general requirements, Section II describes welding procedure qualification, and Section III covers welder qualification. (auth)

1140 REASONING SOLVES A SUPERALLOY POWDER PROBLEM. Wentzell, J. M. (Homogeneous Metals Inc., Herkimer, NY). Metals Eng. Quart.; 14: No. 4, 47-49(Nov 1974).

A method of preventing carbide formation at grain boundaries of sintered In-100 powder metallurgy parts is described. Mechanisms involved in reactions based on additions of Nb are explained. (JRD)

1141 OBRABOTKA DAVLENIEM I MEKHANICHESKIE SVOISTVA TUGOPLAVKIKH METALLOV I SPLAVOV. (Pressure Processing and Mechanical Properties of Refractory Metals and Alloys). Pavlov, I. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). 174p.

Results of studies on the technology of pressure processing of construction materials are compiled in a collection of 28 articles. An analysis is given of the kinematic conditions in the first stages of the rolling process. Effects of the hard tip of the strip on the stress state of the metal during rolling and of the geometric conditions were examined. Resistance to different forms of deformation was considered. Some practical questions on the production aspects are examined. The technology for the processing of a series of refractory and special alloys based on W, Mo, Ni, and Ti is also considered. Separate abstracts were prepared for 14 articles. (tr-auth)

For abstracts of individual papers see: 1142–1153, 1248, and 1249.

1142 NEW METHOD FOR THE EVALUATION OF THE INHOMOGENEITY OF THE DEFORMATION DURING COMPRESSION OF COMPOSITE BLANKS. Pavlov, I. M.; Falaleeva, Z. S.; Shelest, A. E. pp 19-34 of Obrabotka Davleniem i Mekhanicheskie Svoistva Tugoplavkikh Metallov i Splavov. Pavlov, I. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

For an evaluation of the inhomogeneities in the deformation of blanks in cross section, a new indicator and a method for its experimental determination were proposed. Introduction of the indicator would make it possible to obtain information on the behavior of metals and alloys during pressure processing which would facilitate the analysis of the causes for the emergence of special cases of distortion during plastic deformation. Alloys of Mo with B were used as examples. (tr-auth)

1143 ANISOTROPY OF THE LOW-TEMPERATURE DUCTILITY OF TUNGSTEN AS A FUNCTION OF THE ROLLING CONDITIONS. Pavlov, I. M.; Ushakov, E. V.; Drobysheva, E. K. pp 62-66 of Obrabotka Davleniem i Mekhanicheskie Svoistva Tugoplavkikh Metallov i Splavov. Pavlov, I. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

Tungsten with a purity of 99.98 and 99.95% was studied. A large anisotropy of the transition temperature at minimum differences of the crystallographic texture in longitudinal and transverse stress was detected. It was concluded that the low-temperature ductility is essentially determined by the fibrous structure of the deformed metal and with the distribution of impurities. (tr-auth)

1144 TEXTURE OF TUNGSTEN AS A FUNCTION OF THE ROLLING CONDITIONS. Pavlov, I. M.; Drobysheva, E. K.; Babarenko, A. A.; Ushakov, E. V.; Betsofen, S. Ya. pp 66-79 of Obrabotka Davleniem i Mekhanicheskie Svoistva Tugoplavkikh Metallov i Splavov. Pavlov, I. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

Effects of the rolling conditions on the texture of W were studied. Under different rolling conditions, two types of texture were detected: (a) a texture characterized by ideal orientation $\{111\}\langle 1\bar{1}0\rangle$, $\{111\}\langle 11\bar{2}\rangle$, $\{00\bar{1}\}\langle 110\rangle$, and a symmetry peculiar to the texture of cross rolling; and (b) a texture characterized by the presence of the supplementary components $\{113\}\langle 1\bar{1}0\rangle$ and $\{112\}\langle 1\bar{1}0\rangle$. The first type of texture was observed during increased reduction and increased rolling temperature. (tr-auth)

1145 EFFECTS OF THE CONDITIONS OF ROTATION FORGING OF GRADE VA TUNGSTEN ON THE DUCTILE PROPERTIES OF WIRES. Pavlov, I. M.; Ushakov, E. V.; Amosov, V. M.; Karavaitsev, V. L.; Zelentsova, N. M.; Shelest, A. E.; Drobysheva, E. K. pp 79-89 of Obrabotka Davleniem i Mekhanicheskie Svoistva Tugoplavkikh Metallov i Splavov. Pavlov, I. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The effects of a series of parameters of rotation forging of

grade VA W on the tendency of the wires to stratification were studied in detail. It was established that the tendency to stratification can be reduced by use of a guide with a small inlet angle, by reduction of the forging temperature of the rod, and by heating the rod being forged in a carbon-containing atmosphere. (tr-auth)

1146 EFFECT OF THE HOMOGENEITY OF THE STRUCTURE AND PROPERTIES OF CAST TUNGSTEN ALLOYS ON THEIR DEFORMABILITY. Panovko, V. M.; Danil'chenko, A. N.; Kosachev, L. S.; Girshov, V. L.; Shumilova, I. M.; Semiletov, S. S.; Knyazev, V. I.; Popov, A. P. pp 90-96 of Obrabotka Davleniem i Mekhanicheskie Svoistva Tugoplavkikh Metallov i Splavov. Pavlov, I. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The structure and properties of W alloys with carbides were studied. It was shown that the inhibited deformability of the alloys is connected with metastability and the chemical microinhomogeneities of the ingots. The processes for the decomposition of solid solutions of C in W and the inversion of the carbides occurs at 1000 and 1800°C. Thermal processing of the ingots, leading to their reaging, improved the deformability. (tr-auth)

1147 PROFILED ROLLING OF METALLOCERAMIC GRADE VA TUNGSTEN. Pavlov, I. M.; Mekhed, G. N.; Choporov, V. F.; Egorov, B. V. pp 99-104 of Obrabotka Davleniem i Mekhanicheskie Svoistva Tugoplavkikh Metallov i Splavov. Pavlov, I. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The technology of the rolling of rods of metalloceramic grade VA W in calibrated rollers in order to obtain blanks with a diameter of 3 mm for drawing W wires was described. (tr-auth)

1148 PROCESS OF HOT COMPRESSION OF MOLYBDENUM-BASED ALLOYS. Pavlov, I. M.; Falaleeva, Z. S.; Shelest, G. E.; Kurochkina, L. M. pp 110-114 of Obrabotka Davleniem i Mekhanicheskie Svoistva Tugoplavkikh Metallov i Splavov. Pavlov, I. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

Effect of content of the alloying elements in Mo alloys of Mo–B, Mo–B–Ti compositions on the force parameters of compression was studied. The study of the structure and evaluation of the properties in cast and deformed states were made by the microhardness method with statistical processing of the results obtained. (tr-auth)

1149 STRUCTURE, PROPERTIES, AND CHARACTERISTICS OF THE COMPRESSION OF MOLYBDENUM WITH BORON ADDITION IN CASINGS AND WITH GLASS–GRAPHITE LUBRICATION. Pavlov, I. M.; Falaleeva, Z. S. pp 114-120 of Obrabotka Davleniem i Mekhanicheskie Svoistva Tugoplavkikh Metallov i Splavov. Pavlov, I. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The effect of the cast and deformed structure on the force parameters of compression processes of Mo-based alloys was studied. The characteristics of the compression of the Mo alloy in ductile steel casings and with glass-graphite lubrication were established. (tr-auth)

1150 EFFECT OF THE PROCESS OF HYDROSTATIC COMPRESSION ON THE STRUCTURE AND PROPERTIES OF CAST Mo AND GRADE VM-1 Mo. Gural'nik, E. Kh.; Danil'chenko, A. N.; Maksimov, L. Yu.; Makunin, M. S.; Mukhin, G. G.; Panovko, V. M.; Slobtsov, V. E. pp 120-126 of Obrabotka Davleniem i Mekhanicheskie Svoistva Tugoplavkikh Metallov i Splavov. Pavlov, I. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The structural characteristics of the hot compression of grade VM-1 Mo and cast electron-beam fused Mo after hydrostatic compression were described. An analysis was made of the process. (tr-auth)

1151 PARAMETERS OF THE PROCESS OF HYDROSTATIC COMPRESSION OF MOLYBDENUM. Maksimov, L. Yu.; Slobtsov, V. E.; Danil'chenko, A. N.; Mukhin, G. G.; Antonov, Yu. A.; Panovko, V. M.; Gural'nik, E. Kh. pp 126-132 of Obrabotka Davleniem i Mekhanicheskie Svoistva Tugoplavkikh Metallov i Splavov. Pavlov, I. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

Hydrostatic compression of grade VM-1 Mo and electron-beam fused Mo was studied as a function of the force and kinematic indicators of the process and the lubrication conditions. The experimental results were analyzed and the substantial dependence of the pressure of the hydrocompression and the quality of the surface of products obtained by this process on the composition and lubrication conditions was established. (tr-auth)

1152 ROLLING CONDITIONS OF MOLYBDENUM ALLOYS. Pavlov, I. M.; Kopetskii, Ch. V.; Markov, A. M.; Shelest, G. E.; Shtinov, E. D. pp 132-136 of Obrabotka Davleniem i Mekhanicheskie Svoistva Tugoplavkikh Metallov i Splavov. Pavlov, I. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

Effect of temperature-deformation conditions and of the content of alloying elements on the force during rolling and transverse deformation was studied in Mo–B and Mo–B–Ti alloys. Resistance to deformation of these alloys is weakly dependent on the rolling temperature from 700 to 1000°C. The effect of deformation degree on the force during rolling becomes more important as the alloying degree increases. (tr-auth)

1153 INVESTIGATION AND DEVELOPMENT OF THE TECHNOLOGY FOR THE COMPRESSION OF GRADE MB MOLYBDENUM-BASED ALLOYS WITH BORON. Pavlov, I. M.; Falaleeva, Z. S.; Mutovin, V. D.; Chernov, V. S.; Busol, F. I.; Kurochkina, L. M. pp 137-143 of Obrabotka Davleniem i Mekhanicheskie Svoistva Tugoplavkikh Metallov i Splavov. Pavlov, I. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

Results of the investigation are reported and questions on the development of a technology for obtaining semifinished products from grade MB Mo alloys, used as material for the cross arm in oxide–yttrium cathodes, are examined. The alloys considered were Mo–B and Mo–B–Ti. (tr-auth)

1154 BRIDGMAN GROWTH OF LITHIUM INDIUM ALLOY SINGLE CRYSTALS. Kuriyama, K. (Hosei Univ., Tokyo (Japan)). J. Cryst. Growth; 23: No. 2, 160-162(Aug 1974).

Single crystals of the binary alloy lithium–indium were grown by the Bridgman method. A grown boule of 6 mm wide and 20 mm long contained some single crystal domains about 6 × 5 × 5 mm in size. The easiest cleaving plane was the (111) face. Identification was carried out by x-ray diffraction. (auth)

Properties, Structure, and Phase Studies

Refer also to abstracts 641, 1985, 1989, 1991, 1992, and 2516.

1155 (AD-775118) STATUS AND PERSPECTIVES OF THE RADIATION PHYSICS OF SEMICONDUCTORS OF THE A3 B5 GROUP. Mashovets, T. V. Translated by F. C. Vaughn from Radiats. Fiz. Nemetal. Krist.; 3: No. 1, 5-28(1971). 28p. (FTD-HT-23-93-74). NTIS $4.50.

1156 (AD-779627) OPTIMIZATION AND DESIGN CRITERIA FOR BERYLLIUM/TITANIUM COMPOSITES. Interim Report, 1 November 1973–31 January 1974. Sippel, G. R.; Herman, M. (General Motors Corp., Indianapolis, Ind. (USA). Allison Div.). Mar 1974. Contract N00019-74-C-0103. 24p. (EDR-8159). NTIS $3.00.

A program plan for evaluating beryllium/titanium composite materials with respect to method of manufacture, vol. % Be extrusion, and forging reduction is presented. Coextruded Be/Ti powders, as well as coextruded Be rod with a wrought Ti matrix will be investigated. The most cost effective material/process will be fully characterized and design criteria properties determined for gas turbine fan/compressor blades applications. (GRA)

1157 (COO-916-32) STRUCTURE AND PROPERTIES OF SOLID SOLUTIONS. Final Report. Hendrickson, A. A.; Koss, D. A. (Michigan Technological Univ., Houghton (USA). Dept. of Metallurgical Engineering). 1974. Contract AT(11-1)-916. 13p. Dep. NTIS $4.00.

Research on mechanisms of solid solution strengthening in fcc and bcc alloys is summarized. Data and information are included on yield point phenomena, critical resolved shear stress measurements, dislocation motion, and deformation behavior. (JRD)

1158 (COO-2128-8) POSITRON LIFETIME MEASUREMENTS AS A NON-DESTRUCTIVE TECHNIQUE TO MONITOR FATIGUE DAMAGE. Technical Progress Report, January 1973–December 1974. Byrne, J. G. (Utah Univ., Salt Lake City (USA)). Sep 1974. Contract AT(11-1)-2128. 20p. Dep. NTIS $4.00.

Research progress is summarized on fatigue of 4340 steel, electron irradiation, hydrogen embrittlement, and positron lifetime data. (JRD)

1159 (HEDL-TME-74-2(Vol.1)) HEDL QUARTERLY TECHNICAL REPORT, APRIL, MAY, JUNE 1974. Volume 1. Applied Research and Materials Engineering. Evans, E. A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jul 1974. Contract AT(45-1)-2170. vp. AT.

Research programs are reported on ceramic fuels properties, fast neutron absorber materials, control element component technology, irradiation damage to reactor materials, materials performance and surveillance, irradiation damage analysis and sodium technology. (JRD)

1160 (HEDL-TME-74-38) EFFECT OF THERMAL AGING ON THE HIGH STRAIN RATE TENSILE PROPERTIES OF TYPE

304 STAINLESS STEEL. Steichen, J. M. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jul 1974. Contract AT(45-1)-2170. 36p. Dep. NTIS $4.00.

The influence of thermal aging at 800, 1000, and 1200°F on the high strain rate tensile properties of Type 304 stainless steel has been experimentally determined. Specimens were aged in static sodium for exposures of 1000, 3500 and 10,000 hours. Tests were performed at room temperature at a strain rate of 3×10^{-5} s^{-1} and the respective aging temperatures at strain rates from 3×10^{-5} to 10 s^{-1}. Aging at temperatures to 1000°F did not alter the elevated temperature strength, ductility, or strain rate sensitivity of the subject material. Aging at 1200°F did not alter the 1200°F strength properties of Type 304 stainless steel; however, ductility was increased at the lowest strain rates and slightly reduced at the higher test rates. Thermal aging for 10,000 hours slightly reduced the room temperature ductility and had little effect on strength of the subject material. (auth)

1161 (HEDL-TME-74-39) HIGH STRAIN RATE TENSILE PROPERTIES OF 20% C. W. TYPE 316 STAINLESS STEEL. Steichen, J. M. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jun 1974. Contract AT(45-1)-2170. 37p. AT.

Testing was performed on prototypic FTR fuel cladding and rod specimens. Test parameters included temperatures from room temperature to 1600°F and strain rates from 3×10^{-5} to 10 in./in./sec. At test temperatures to 1000°F, the strength and ductility were largely insensitive to strain rate. At temperatures of 1200°F and above, strength properties and uniform elongation were observed to increase and total elongation to decrease with increasing strain rate. Thermal aging at 1200°F for durations to 10,000 hours slightly reduced the strength and increased the ductility of the subject material without significantly altering the strain-rate sensitivity. (15 fig, 8 tables) (auth)

1162 (LA-5730-MS) ANOMALOUS SINTERING BEHAVIOR IN THE 95% W-3.5% Ni-1.5% Fe COMPOSITE. Zukas, E. G.; Sheinberg, H. (Los Alamos Scientific Lab., N. Mex. (USA)). Aug 1974. Contract W-7405-eng-36. 16p. Dep. NTIS $4.00.

During liquid-phase sintering of W-Ni-Fe composites, single crystal spheroids of essentially pure tungsten form in a W-Ni-Fe matrix. These spheroids grow in a systematic way if either the sintering time is increased, or if the sintering temperature is raised. The generally accepted mechanism of spheroid growth is the dissolution of the small spheroids with simultaneous reprecipitation of tungsten from the molten matrix onto the larger ones, the reaction being driven by surface energy differences between the small and large spheroids. It has been shown theoretically that for such reactions, the plot of log diameter-log time will give a straight line of slope $\frac{1}{3}$. This theory has been modified to include a rearrangement process for achieving densification during the early stages of sintering and a coalescence process for combining solid spheroids during the latter stages of sintering. Furthermore, sintering at different temperatures should proceed with a single-valued activation energy since a single growth mechanism is rate controlling. The sintering behavior of a low volume matrix alloy (95% W-3.5% Ni-1.5% Fe) was studied. It was found that the slope of the log diameter-log time plot was less than $\frac{1}{4}$, and that the growth process could not be represented by a single-valued activation energy. These experiments as well as those generally published in the literature have several shortcomings in that they do not consider the effect of solid state reactions during presintering, nor the effect of sintering temperature on the spheroid nucleation size. Furthermore, determining activation energies after a constant sintering time does not evaluate structural differences. To overcome these objections, a second series of experiments was conducted in which the baseline material had already been liquid-phase sintered, and the growth rates determined after additional sintering. Activation energies were determined from the times required at the different sintering temperatures to achieve equivalent structures. In these tests, the log diameter-log time plots had slopes less than $\frac{1}{4}$ and the activation energies were different for different sintering conditions. These results indicate that the dissolution-reprecipitation process is not rate controlling in the 95% W-3.5% Ni-1.5% Fe composite. It is felt that the growth rates are too fast for such a process to be rate controlling, and that "coalescence," i.e., the joining of two or more spheroids that come into contact at the proper crystallographic orientation and form a single spheroid, is much more important even during the initial stages of sintering. The rate of such a growth mechanism would depend on some degree of matrix circulation, and the probability for proper spheroid contact. Thermal activation, then, would mean an increase in the matrix circulation and perhaps a greater acceptable angle of contact for welding. Since such a process is not diffusion controlled, but depends on probability, growth rates would behave in a systematic way, but not in accordance with any particular growth rate or activation energy. (auth)

1163 (ORNL-TM-4627) INTERIM REPORT OF TENSILE AND CREEP DATA FOR TYPE 304 STAINLESS STEEL PLATE (REFERENCE HEAT 9T2796, 2 IN. THICK). McCoy, H. E. (Oak Ridge National Lab., Tenn. (USA)). Oct 1974. Contract W-7405-eng-26. 72p. AT.

The uniaxial tensile and creep properties of the type 304 stainless steel reference heat 9T2796 (2 in.-thick plate product form) were measured. The tensile properties were determined as a function of strain rate from 0.0004 to 0.4/min at temperatures from 25 to 704°C. Test equipment was developed for running low-strain creep tests for long periods of time. Creep tests are in progress over the range 427 to 704°C. Many of the tests are scheduled for 50,000 h and several have exceeded 10,000 h. The results of these tests are analyzed in several ways and compared with currently accepted design values. The yield stress of the reference heat in the reannealed condition was less at all test temperatures than the minimum strength specified by the Code. The rupture time at a given stress level was slightly greater for the reference heat than the specified minimum value. However, the rupture times were less and the creep rates greater than for most heats included in current compilations. (auth)

1164 (ORNL-TM-4688) FUELS AND MATERIALS DEVELOPMENT PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING JUNE 30, 1974. Patriarca, P. (Oak Ridge National Lab., Tenn. (USA)). Oct 1974. 180p. AT.

Research progress is summarized on properties of europium oxide absorber materials, LMFBR steam generator and heat exchanger materials, properties of LMFBR structural and component materials, and properties of LMFBR weldments. (JRD)

1165 (SAND-74-5221) TEMPERATURE DEPENDENT INTERNAL FRICTION FOR URANIUM, U-0.78 W/O Ti, U-6 W/O Mo, AND U-10 W/O Mo. Laats, E. T.; Schmidt, T. R.; Reuscher, J. A. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 11p. (CONF-741017-8). Dep. NTIS $4.00.

From meeting of the American Nuclear Society; Washington, District of Columbia, USA (27 Oct 1974).

The technique employed was to use a pulsed reactor (SPR II) to rapidly fission heat the rod specimen so that stress waves are induced, resulting in an oscillatory motion of the rod ends. U and U-0.78% Ti were in the wrought alpha phase, while the two Mo alloys were gamma phase-stabilized (arc cast). Results show that U has the largest internal friction, followed by U-0.78% Ti, U-6% Mo, and U-10% Mo in that order. (DLC)

1166 (UCRL-13605) CHARACTERISTICS OF COMMERCIAL VACUUM-HOT-PRESSED BERYLLIUM. III. Effect of Heat Treatment and Pressurization on the Properties of Hot-Pressed Block HY. Summary Report. Gelles, S. H. (Battelle Columbus Labs., Ohio (USA)). Aug 1974. Contract W-7405-eng-92. 51p. Dep. NTIS $5.75.

For Univ. of California, Livermore.

Continuing work to characterize hot-pressed beryllium block HY which had shown brittle behavior in the pressing direction at 260°C has been concerned with the effect of heat treatment and pressure treatment on the structure and tensile properties of the metal. The heat treatment consisted of 8 hours at 1090°C followed by a cool at a linear rate to 750°C in 8 hours and then cooling to room temperature in 24 hours at a linear rate. Tensile properties were evaluated at room temperature, 149 and 260°C, respectively, at strain rates of 0.0385 and 38.5 per minute. The heat treatment reduced the yield and ultimate tensile strengths, improved the tensile ductility, and somewhat reduced the tendency for embrittlement at the lower strain rate. However, at a strain rate of 38.5 per minute, pronounced embrittlement was still observed in the pressing direction at both 149°C and 260°C. Structural changes accompanying the heat treatment consisted of a small increase in grain size (8.8 to 11.2 μ), a small decrease in density (1.853 to 1.851 g/cm^3), and changes in the size and type of minor phases in the structure. The pressurization treatment to 21,000 atmospheres (308,600 psi) was found to restore the ductility of the as-received samples of hot-pressed block HY. This observation has pinpointed the source of embrittlement in this material and in a hot isostatically pressed P-21 sample similarly treated as a deficiency in mobile dislocations probably due to solute, precipitate, or inclusion pinning. (auth)

1167 (UCSD-34P143-47) RESEARCH ON THE PROPERTIES MATERIALS AT VERY LOW TEMPERATURES. Annual Progress Report for July 1970-July 1971. Wheatley, J. C. (California Univ., La Jolla, San Diego (USA). Dept. of Physics). Aug 1971. Contract AT(04-3)-34. 93p. Dep. NTIS $7.75.

A list is attached of articles which were published in this period, those in press and submitted, Ph. D. theses accepted, patent disclosures, and other activities of the principal investigator. Work in progress but not yet completed is given special attention. (MHR)

1168 ANOMALOUS SMALL-ANGLE MAGNETIC SCATTERING FROM AMORPHOUS $TbFe_2$ AND YFe_2. Pickart, S. J.; Rhyne, J. J.; Alperin, H. A. (Naval Ordnance Lab., Silver Spring, MD). Phys. Rev. Lett.; 33: No. 6, 424-427(5 Aug 1974).

Small-angle quasielastic neutron scattering measurements have revealed an intense magnetic component at low temperatures in amorphous $TbFe_2$ and YFe_2, in addition to a weak critical divergence at T_c in $TbFe_2$. These observations are interpreted as evidence that spatial fluctuations remain "frozen in" below the Curie point of $TbFe_2$, and that only short-range order is achieved in YFe_2. (auth)

1169 DIRECT MEASUREMENT OF THE PAIR DISTRIBUTION FUNCTION FOR ADATOMS ON A SURFACE. Graham, W. R.; Ehrlich, G. (Univ. of Illinois, Urbana). Phys. Rev. Lett.; 32: No. 23, 1309-1311(10 Jun 1974).

The distribution function governing the equilibrium separation of two atoms on a single crystal plane has been measured for the first time. Quantitative determinations for tungsten atoms self-adsorbed on the (211) and (321) planes of tungsten reveal that, for interatomic distances $R > 7$ Å, the behavior of the atoms conforms to that of independent particles. Long-range interactions are below the detection limit of $\approx kT/2$, where T is the equilibration temperature, in agreement with present theories of interatomic interactions. (auth)

1170 RARE EARTH IONS IN A HEXAGONAL FIELD. III. Segal, E.; Wallace, W. E. (Univ. of Pittsburgh). J. Solid State Chem.; 11: No. 3, 203-213(Nov 1974).

Energy levels and magnetic moments of rare earth ions in a crystal field of hexagonal symmetry have been obtained using a Hamiltonian of the form, $\mathcal{H} = \mu_B g\, J \cdot H + B_2^0 O_2^0 + B_4^0 O_4^0 + 77/8\ O_6^0$. Selected results are presented for all J values appearing in the rare earth series and for values of the parameters covering the situations in which the crystal field is dominant, in which the interaction with the magnetic field is dominant and in which the two interactions are comparable in magnitude. The case in which the magnetic field is directed perpendicular to the hexagonal axis is analyzed. (auth)

1171 FLOW STRESS ASYMMETRY IN CYCLIC DEFORMATION OF MOLYBDENUM CRYSTALS. Etemad, B.; Gulu, F. (Queen Mary Coll., London). Scr. Met.; 8: No. 8, 931-935(Aug 1974).

The asymmetry of the flow stress in Mo single crystals as revealed by cyclic deformation of samples with different axial orientation is reported. It is noted that asymmetry appears at about the same stress for ⟨100⟩ and ⟨110⟩ crystal orientations which suggests that the onset of plastic deformation (or microyield stress) is independent of crystal orientation. (JRD)

1172 ISOTOPE EFFECT IN VANADIUM–HYDROGEN AND DEUTERIUM ALLOYS. Abe, F. (Tohoku Univ., Japan); Hanada, R.; Kimura, H. Scr. Met.; 8: No. 8, 955-958(Aug 1974).

Results of a study of the mobility of H and D in V during quenching at 4°K and subsequent annealing are presented. It was found that D diffuses with greater motional activation energy than that of H in V between 30 and 600°K. (JRD)

1173 RECOVERY OF THE ELECTRICAL RESISTIVITY IN Ta DEFORMED AT 4°K. Peretti, H. A. (Universidad Nacional de Cuyo, Bariloche, Argentina); Schoeck, G. Scr. Met.; 8: No. 8, 985-990(Aug 1974).

The increase of electric resistivity in Ta deformed at liquid He temperature and the subsequent recovery at room temperature were investigated. The recovery process may be controlled by continuous release of trapped interstitials during warmup. (JRD)

1174 COPPER–BERYLLIUM ALLOYS IN THE VICINITY OF THE EUTECTOID COMPOSITION. Auvray, X.; Graf, R.; Guinier, A. (Faculty of Sciences, Mt. St. Aignan, France). Scr. Met.; 8: No. 8, 995-1004(Aug 1974). (In French).

The alloy with 6 wt% Be has a eutectoid composition and at high temperatures is in the disordered cubic centered β form. The decomposition of the β phase was studied using x-ray techniques primarily. The study showed that the β form can not be retained at room temperature because it is immediately ordered by rejecting the excess Cu and the structure is then face-centered quadratic before evolving into its stable form. The passage of a cubic centered structure into a face centered cubic structure through an intermediate phase obtained after tempering was established. This intermediate phase is transformed into a stable phase by germination and growth during tempering. These results differ from those obtained by other authors who used a more rapid tempering. This transformation is comparable to the $\gamma \rightarrow \alpha$ transformation of ferrous alloys. (JSR)

1175 EXPERIMENTAL MUFFIN TIN POTENTIAL PARAMETERS FROM FERMI SURFACE DATA. Devillers, M. A. C. Nijmegen, Netherlands; Katholieke Univ. (1974). 136p.

Thesis.

From many considerations one can argue that the logarithmic derivatives of the muffin tin model should be good parameters for the description of a Fermi surface. This has been shown for the examples white tin, copper, and mercury. Also investigated is whether the parameters obtained have any physical significance other than for Fermi surface interpolation purposes. An application was found in using these parameters in a theoretical expression for the specific resistivity (and its volume derivative) of liquid metals. An apparent E_F-ambiguity was found and explained by a theory based on local pseudopotentials. Some consequences of the E_F-ambiguity for the fitted parameters and the relationship of them with the "focus point" parameters of Andersen were analyzed. Also the relations between Bloch theory of crystalline metals and scattering theory of densely packed scattering potentials were clarified considerably. As to the present state of scattering theory in metals, a modified theory is advanced which accounts better for the kinematics of the conduction electrons and at the same time gives rise to the incorporation of second-order effects in band structure theory in a very simple way. (NL)

1176 RADIO-FREQUENCY SIZE EFFECT MEASUREMENTS AND THE FERMI SURFACE IN INDIUM. de Groot, D. G. Amsterdam; Vrije Univ. (1974). 119p.

Thesis.

The Fermi surface and the mean free paths of indium were determined by the radio-frequency size effect (R. F. S. E.) method. The effect of the experimental arrangement, the excitation mode, the temperature and the surface scattering of the charge carriers were studied. An extensive description is given of the double-sided (twin-T bridge arrangement) and the single-sided (hollow box transmission arrangement) excitation set-ups in connection with the separation of the real and imaginary part of the surface impedance. The line shapes obtained with the two experimental arrangements are presented. The line shapes obtained with double-sided excitation agree roughly with those calculated by Juras. Mean free paths are calculated from the magnetic field induced surface states cut-off field and the temperature dependence of some R. F. S. E. peaks. The results are in accordance with earlier experiments. The Fermi surface of indium was calculated with a K. K. R. Z. interpolation scheme by fitting three parameters to four selected linear dimensions of the Fermi surface, determined experimentally. The Fermi surface calculated with these parameters is in accordance with the experimental results for many orientations of the magnetic field within the experimental error. (NL)

1177 CRYSTALLOGRAPHY OF EPITAXIALLY GROWN MOLYBDENUM ON SAPPHIRE. O'Neal, J. E.; Rath, B. B. (McDonnell Douglas Corp., St. Louis). Thin Solid Films; 23: No. 3, 363-380(Oct 1974).

Molybdenum thin films were deposited onto (0001), $(\bar{1}012)$, and $(10\bar{1}2)$ sapphire substrates by electron-beam evaporation in ultrahigh vacuum. The surface morphology and crystallographic orientation of these films were characterized by electron microscope replication and reflection electron diffraction. The effect of the crystallographic plane of the sapphire substrates as well as that of the deposition rate on the crystallographic orientation of the deposited molybdenum films were examined in the temperature range 25 to 1000°C. The epitaxial temperature range was 600 to 900°C for basal plane substrates and 300 to 1000°C for $(\bar{1}012)$ and $(10\bar{1}2)$ substrates. The orientation of the deposited film was strongly dependent on that of the sapphire substrate. (auth)

1178 EFFECT OF AUSWORKING ON THE STRENGTH OF TYPE 420 STAINLESS STEEL WITH THE ADDITION OF CARBIDE-FORMING ELEMENTS. Ober, R. F. University Park, PA; Pennsylvania State Univ. (1973). 87p. University Microfilms Order No. 74-20,955.

Thesis (Ph. D.).

The effect of ausworking on AISI Type 420 stainless steel has been studied from a property and structural viewpoint. Strong carbide-forming elements (tungsten, molybdenum, titanium, and vanadium) were added to the base alloy. Five different processes were considered: no ausworking; ausworking at 550 and 430°C; ausworking immediately upon reaching the deformation temperature and after holding the samples at the deformation temperature until the initiation of proeutectoid carbide separation occurs. The

amount of deformation was always in the range 50 to 55% reduction in area. All of the samples were austenitized at 1200°C for ½ hour prior to ausworking and tempered for two hours at 300°C after ausworking. The proportional limit, 0.2% offset yield strength, and ultimate tensile strength were measured. The mechanical property data revealed a significant difference in the samples which were ausworked compared to those which were not deformed. The percent increase in strength was not significantly dependent upon the temperature of ausworking. In addition, the time that the samples were held at temperature was also found to be insignificant. By the use of high resolution dark field electron microscopy a very small (30 Å to 180 Å), finely dispersed carbide precipitate was found. The formation of the precipitate was associated with an increased dislocation density resulting from ausworking. The strain induced precipitate is used to explain the mechanical property data measured in this work. The formation of finely dispersed carbides and the increase in dislocation density enhances the mechanical properties of the ausworked materials as compared to the unausworked ones. The mechanical properties were found to be only slightly improved by the addition of carbide-forming elements. All of the elements studied (W, V, Ti, and Mo) seemed to have the same effect. No one element was found to be better than the others within the range of compositions studied. (Diss. Abstr. Int., B)

1179 STATE OF INTERSTITIAL IMPURITIES IN NIOBIUM ALLOYS. Zvezdin, Yu. I.; Chelnokov, V. A.; Chumachenko, V. N.; Yakovlev, V. A. Tr. Leningrad. Politekh. Inst.; No. 331, 98-103 (1973). (In Russian).

The relation between the changes in the mechanical properties during thermal processing the changes of the state of interstitial impurities in unalloyed Nb and its alloys was studied. Oxygen and nitrogen after annealing with T > 1000°C are bound in Nb–0.5 Zr and Nb–1.0 Zr alloys in interstitial phases. In Nb–2.0 Zr–0.1 N alloy quenched from 1800 to 1950°C, the nitrogen forms Zr–N complexes. Annealing at temperatures below 1000°C causes the appearance of coherent ZrN precipitates. At very high temperatures incoherent precipitates are formed. In the Nb–2.0 Zr–0.1 N after annealing at 1300°C all the Zr enters into the composition of the incoherent precipitate. (tr-auth)

1180 BERYLLIUM: A LIGHT-WEIGHT RARE EARTH METAL. Chih, Y. P. K'o Hsueh Shih Yen; No. 6, 30-32(Jun 1974). (In Chinese).

Because of outstanding properties such as its light weight, high heat absorbing capacity, and strength, beryllium is found increasingly in sophisticated technological applications. The use of beryllium and compounds for neutron decelerator, fuel disperser, and neutron source in atomic pile reactions is described. Be and its compounds are also used in antennas, lightweight heat absorbing shields, outer casing of payload connectors in missile and space flight applications, in body casing for turbojets, in gyroscopes used as stabilizers for aircraft, boats, guided missiles, and space ships. Beryllium reinforced compounds, beryllium oxide ceramics for transistor and semiconductor use, and beryllium as a high-energy fuel for missiles and rockets are also discussed. (JPRS)

1181 EFFECT OF ALLOYING ON THE DEFORMATION STRENGTHENING OF TWIN BANDS IN BISMUTH AND BERYLLIUM CRYSTALS UNDER STRESS PULSATIONS. Bashmakov, V. I.; Bosin, M. E.; Lavrent'ev, F. F.; Papirov, I. I. (Kharkov Inst. of Public Power Supply). Strength Mater. (USSR) (Engl. Transl.); 6: No. 1, 79-83(Jan 1974).

Translated from Probl. Prochnosti; 6: No. 1, 80-84(Jan 1974).

An investigation was conducted to determine the nature of the loss of strength by individual twins on unloading the crystal, and to study possible mechanisms of strengthening on subsequent stress pulsations, in bismuth and beryllium crystals. Since alloying greatly influences the characteristics of the slip taking place in the vicinity of the twins, studies were also made to determine the effect of alloying additions on the strengthening of the twin boundaries. Most of the results were obtained under conditions of stress pulsation, as by this means a number of features of the strengthening of individual twins can be observed. Results show that the effect of the loss of strength on unloading twinned crystals and its recovery on subsequent pulsation is attributable to the dual role of the slip that accompanies twinning. On the one hand slip reduces the internal stresses at the twin boundaries, causing weakening; while on the other, slip leads to saturation of the lattice with sessile dislocations, which results in subsequent strengthening of the regions bordering on the twins. (auth)

1182 LINE WIDTH OF THE FERROMAGNETIC RESONANCE IN SINGLE-CRYSTALS OF Ni_3Fe ALLOYED WITH MOLYBDENUM AND COPPER. Puzei, I. M.; Pokatilov, V. S. Fiz. Metal. Metalloved.; 37: No. 6, 1314-1317(Jun 1974). (In Russian).

It is known that alloying of Ni_3Fe either conserves or suppresses ordering. Moreover, certain elements, for example, molybdenum, cause a decrease in the magnetic moments of the components of an alloy and lead to a redistribution in the vicinity of alloying element atoms. Copper also disturbs the far order. The line width of the ferromagnetic resonance was investigated on massive single crystals of Ni_3Fe containing zero, 1.5, 3.0, and 5.0 at. % Mo or Cu. In the unordered state an increase in line width ΔH is observed with increasing concentration of molybdenum. Ordering of the alloys containing molybdenum led to a decrease in line width and to a more rapid growth in line width with an increase in molybdenum content. The line widths of the ordered and unordered molybdenum alloys are the same at 4 to 4.5 at. % Mo. As in the case of molybdenum, an addition of copper only slightly increases the line width in the unordered state. After ordering, the line width decreases, but copper suppresses the far order more weakly than molybdenum does. (SJR)

1183 EFFECT OF CRYSTAL GRAIN BOUNDARIES ON THE RESIDUAL ELECTRICAL RESISTANCE OF TIN, CADMIUM, ZINC, AND INDIUM. Aleksandrov, B. N.; Kan, Ya. S.; Tatishvili, D. G. (Physical-Technical Inst. of Low Temperatures, Kharkov). Fiz. Metal. Metalloved.; 37: No. 6, 1150-1158(Jun 1974). (In Russian).

On cylindrical wires of Sn, Cd, In, and Zn of high purity (~99.9999%), measurements were made of the effect of separate grain boundaries on the residual resistance. The results are: δ_0 (average) = 0.76×10^{-11} ohm-cm^2 for tin, 1.7×10^{-11} for cadmium, 2.3×10^{-11} for indium and 5×10^{-11} for zinc. The effect of a single concrete boundary on ρ_0 was estimated. It is shown that in the case of tin and zinc this effect depends on the degree of crystallographic disorientation of the adjacent crystal grains. It is noted that with decreasing chemical purity of the metals, the value of ρ_0 should decrease. It is also estimated that the effect of twins on the value of δ_0 of high-purity cadmium is a factor of ~10 less than the effect of the grain boundaries. (tr-SJR)

1184 TEMPERATURE AND CONCENTRATION DEPENDENCE OF MECHANICAL PROPERTIES, AND THE DISLOCATION STRUCTURE OF MOLYBDENUM–RHENIUM ALLOYS. Tyumentsev, A. N.; Freze, N. I.; Pochivalov, Yu. I.; Kolobov, Yu. R.; Korotaev, A. D. Fiz. Metal. Metalloved.; 37: No. 6, 1256-1265(Jun 1974). (In Russian).

A study was made of the temperature dependence of mechanical properties and of the dislocation structure of Mo–Re alloys having different concentrations of rhenium. It is shown that alloying molybdenum with rhenium in the absence of mechanical twinning increases the temperature dependence of mechanical properties at a rhenium content up to 30 wt %. A decrease of the temperature dependence of an arbitrary yield point in concentrated Mo–Re alloys is caused by the effect of twinning. This conclusion was confirmed in studying micro- and macro-flow at $T < 0.2\ T_{melt}$ of an alloy Mo + 47% Re + 0.8% ZrC. The results are explained by a decrease in mobility of screw dislocations as a result of a decrease in packing defect energy on alloying molybdenum with rhenium. The conclusions concerning a decrease in the mobility of screw dislocations was confirmed during a direct electronmicroscopic study of the dislocation structure of the alloys under investigation in the temperature interval of 273 to 873°K. (tr-SJR)

1185 TRITIUM DIFFUSION IN ZIRCALOY-2 IN THE TEMPERATURE RANGE –78 TO 204°C. Austin, J. H.; Elleman, T. S.; Verghese, K. (North Carolina State Univ., Raleigh (USA). Dept. of Nuclear Engineering). J. Nucl. Mater.; 51: No. 3, 321-329(Jul 1974).

Tritium diffusion measurements in Zircaloy-2 were carried out over the temperature range –78 to 204°C by direct measurement of tritium diffusion gradients. The $^6Li(n,\alpha)^3H$ reaction was used to inject tritium into the specimens and to produce initial tritium concentration in the range 0.0065 ppM to 0.013 ppM ^3H by weight. Two diffusion components were identified from the concentration profiles: a surface trapping region approximately 5 μm thick and a normal diffusion profile characteristic of bulk diffusion. Surface release measurements of tritium verified the existence of a surface trapping layer. The bulk diffusion component was consistent with classical diffusion solutions and was given by: $D = 0.00021^{+0.0011}_{-0.00018}$ exp-(8500 ± 200 cal/RT) cm^2 sec^{-1}. The surface trapping was attributed to oxide films formed on the Zircaloy-2 at room temperature. The apparent diffusion coefficients for the surface region were consistent with: $D = 4.0^{+11}_{-3.3} \times 10^{-14}$ exp-(7200 ± 1500 cal/RT) cm^2 sec^{-1} over the temperature range 25 to 411°C. (auth)

1186 WORK HARDENING AND DUCTILITY OF Zr–1.14% Cr–0.1% Fe. Holt, R. A. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). J. Nucl. Mater.; 51: No. 3, 309-320(Jul 1974).

The effects of metallurgical conditions and irradiation at 573 and 723°K on the work-hardening behavior of Zr–1.14 wt % Cr–0.1 wt % Fe are described. Irradiation at both temperatures reduced the initial work-hardening rates. Cold-worked and β-treated materials had higher work-hardening rates than α-annealed material after irradiation at 573°K. Uniform elongation and thus total elongation are related to the work-hardening exponent κ. Thus for any condition or test temperature the uniform elongation is a function of strength and work-hardening rate. A drastic decrease observed in uniform elongation of α-annealed material due to irradiation results from a large increase in yield stress and a large decrease in the work-hardening rate. Similarly the variation in uniform elongation of α-annealed material with temperature correlates with the variation in work-hardening rate and yield strength with temperature. (auth)

1187 SOUND VELOCITY IN LIQUID PLUTONIUM. Merz, M. D.; Hammer, J. H.; Kjarmo, H. E. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). J. Nucl. Mater.; 51: No. 3, 357-358(Jul 1974).

The velocity of sound in liquid plutonium and liquid Pu–1 wt % Ga alloy was measured at temperatures between the melting points and 950°C. In each case the velocity increased with temperature and the amount of increase was consistent with the reported decrease in density with increasing temperature for the two liquids. (auth)

1188 SELF-HEATING EFFECTS IN THE DENSITY MEASUREMENT OF PLUTONIUM WITH THE DISPLACEMENT METHOD. Soederqvist, R.; Schill, I. (The Research Institute of the Swedish National Defence, Division of Materials Research, Fack, S-10450 Stockholm 80, Sweden). J. Nucl. Mater.; 51: No. 3, 359-360(Jul 1974).

During investigations on the precise determination of the density of plutonium metal, effects were found that seriously limited the obtainable precision of the displacement method. By substituting the plutonium metal by an electrically heated lead-base metal specimen it was possible to show that the well-known self-heating effect acted on the specimen in different ways. The apparent weight decreased when the specimen was heated. A subsequent analysis of the phenomena showed that it is possible that at least three different forces resulting from self-heating were acting on the specimen. (auth)

1189 STUDIES OF THE MOBILITY OF HELIUM IN VANADIUM. Smidt, F. A. Jr.; Pieper, A. G. (Naval Research Lab., Washington, D. C. (USA)). J. Nucl. Mater.; 51: No. 3, 361-365(Jul 1974).

Two of the most serious materials problems in liquid metal fast breeder reactors and controlled thermo-nuclear reactors, void formation and helium embrittlement, require an understanding of the mobility of helium in metals for their interpretation. The present study of the mobility of helium in vanadium utilizes a combination of a newly developed $\alpha-\alpha$ scattering technique, to determine helium concentration profiles, and quantitative transmission electron microscopy (TEM) to study bubble formation. (auth)

1190 NEUTRON DIFFRACTION STUDY OF ANTIFERROMAGNETIC $TbIn_3$. Crangle, J. (Sheffield Univ. (UK). Dept. of Physics). Phys. Lett., A; 48: No. 5, 370-372(15 Jul 1974).

Observations were on a polycrystalline sample using unpolarized neutrons, at temperatures of 4.2°K and 100°K. There is 1 1 0 antiferromagnetic ordering. The magnetic moment is $7.2 \pm 0.4\ \mu_B$, with its direction close to that of the c-axis. (auth)

1191 POLYMORPHISM OF METALLIC YTTERBIUM FROM DATA ON THERMOPOWER, HALL EFFECT AND ELECTRICAL RESISTIVITY. Vedernikov, M. V.; Burkov, A. T.; Dvunitkin, V. G.; Moreva, N. I. (AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.). Phys. Lett., A; 48: No. 4, 293-294(1 Jul 1974).

Thermopower, Hall effect and resistivity of massive pure metallic ytterbium samples were measured in the temperature range 77 to 700°K. Anomalies are observed in these three properties at 590°K. A conclusion is drawn on a polymorphic transformation of pure ytterbium at 590°K from fcc to hcp modification. Thus ytterbium reveals four polymorphic modifications in all, hcpI → fcc → hcpII → bcc. (auth)

1192 COALESCENCE OF HELIUM BUBBLES IN ALUMINUM. Chen, K. Y.; Cost, J. R. (Purdue Univ., Lafeyette, Ind. (USA). School of Materials Science and Metallurgical Engineering). J. Nucl. Mater.; 52: No. 1, 59-74(Aug 1974).

The formation and coalescence of helium bubbles in aluminum with annealing at 550°C is examined experimentally using electrical resistivity and electron microscopy. Results for the kinetics of coalescence are compared with those obtained by computer simulation in order to test models based upon various mechanisms for bubble motion. The computer method previously developed is extended from an ideal to a Van der Waals gas and effects due to the surface energy of aluminum are considered. Comparison of experimental and computer results indicates that the motion of helium bubbles in aluminum is not surface-diffusion limited and that it is consistent with the facet nucleation-limited mechanism originally proposed by Willertz and Shewmon. (auth)

1193 INTERNAL FRICTION STUDY OF ZIRCONIUM ALLOYED WITH HYDROGEN AND DEUTERIUM. Provenzano, V.; Schiller, P.; Schneiders, A. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). J. Nucl. Mater.; 52: No. 1, 75-84(Aug 1974).

Internal friction measurements have been performed on high-purity zirconium charged with various amounts of hydrogen and with deuterium. The internal friction spectrum of zirconium, alloyed either with hydrogen or with deuterium, shows the presence of three damping peaks in the temperature range between –200°C and 550°C and in a frequency range between 800 Hz and 11,000 Hz. The internal friction data also show the presence of a rather pronounced deformation peak after plastic deformation. The mechanisms proposed to explain each peak are (1) the peak appearing in the low-temperature region is assumed to be due to dislocations; (2) the peak appearing in the intermediate temperature is connected with the transitional phase γ', proposed by Jack and later elaborated on by Gulbransen and Andrew; and (3) the peak in the high-temperature region is attributed to the dissolution and the formation of zirconium hydride precipitates within the zirconium matrix. The solid solubility limit of hydrogen in zirconium has been computed from the internal friction data and agrees well with the values in the literature. (auth)

1194 AN INVESTIGATION OF SECOND PHASE PARTICLES IN ZIRCALOY-4 ALLOYS. Vander Sande, J. B.; Bement, A. L. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Metallurgy and Materials Science). J. Nucl. Mater.; 52: No. 1, 115-118(Aug 1974).

The corrosion resistance, grain growth behavior and general mechanical behavior of Zircaloy and related zirconium alloys depend upon the distribution and morphology of intermetallic precipitates in these alloys. However, in the compositionally complex Zircaloys, the chemical nature of the second phase particles, as well as the distribution and size of these particles, must be determined if the composition of the alloys is to be altered to maximize specific behavioral characteristics. This letter describes methods developed for the detailed characterization of second phase particles having sizes in the submicron range in zirconium alloys and the results of initial studies of these particles in Zircaloy-4 and in a Zr-5.0 Sn alloy. (auth)

1195 REPLY TO "COMMENTS ON OXYGEN ANALYSIS OF SODIUM BY EQUILIBRATION WITH VANADIUM: AN ASSESSMENT". Hooper, A. J.; Trevillion, E. A. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). J. Nucl. Mater.; 52: No. 1, 119-122(Aug 1974).

Smith has disputed the findings of Hooper and Trevillion on the vanadium equilibration technique for measuring oxygen in sodium on the grounds of the errors associated with the thermodynamic data used by Hooper and Trevillion and of the general acceptance of the method by other US laboratories. The principal findings of Hooper and Trevillion on the vanadium equilibration technique as described by Smith et al. were that the method cannot be used to measure oxygen activities in sodium, that thermodynamic equilibrium was not achieved between solutions of oxygen in sodium and vanadium at the oxygen concentrations quoted, and that the range of oxygen concentrations in sodium measurable by the technique would be attenuated greatly if thermodynamic equilibrium had been achieved. However, it was agreed that the technique may be useful if the concentration of oxygen in vanadium can be related to an accurately measured concentration of oxygen in sodium when the activities of interfering impurities are specified. (auth)

1196 CRYSTAL STRUCTURES OF INTERMEDIATE PHASES IN SEVERAL NEPTUNIUM BINARY ALLOYS. Mitchell, A. W.; Lam, D. J. (Argonne National Lab., Ill. (USA)). J. Nucl. Mater.; 52: No. 1, 125-127(Aug 1974).

The alloying behavior of binary alloys of neptunium with aluminum platinum, thallium, tin and silicon near the 1:1, 1:2, and 1:3 composition region was investigated. The crystal structure and the lattice constants of $NpAl_2$, NpPt, $NpPt_3$, Np_2Tl, Np_3Sn, $NpSn_3$, and Np_2Cl_2 are reported. The calculated and observed d-spacings and the calculated and observed line intensities for $NpSn_3$ and Np_2Tl are also reported. (auth)

1197 A RESISTOMETRIC STUDY OF AGEING IN NIMONIC ALLOYS. I. PE16. White, R. J.; Fisher, S. B.; Miller, K. M.; Swallow, G. A. (Central Electricity Generating Board, Kerkeley (UK). Kerkeley Nuclear Labs.). J. Nucl. Mater.; 52: No. 1, 51-58(Aug 1974).

The Nimonic alloy PE16 is a candidate for use in a radiation environment in fast reactors. Williams and Fisher have investigated void-swelling in this alloy and have found it to be dependent upon the γ' precipitate present. In order to investigate the dependence of precipitation upon heat-treatment, the variation of the electrical resistivity with time on ageing PE16 at various temperatures between 580°C and 780°C was measured. To account for the observed variation a model based on nucleation and growth of γ' precipitates was developed. This model allows for different scattering cross sections, and hence specific resistivities of particles in small and large clusters. The rate constants for nucleation and growth are found to follow the usual Arrhenius behavior with activation energies of 1.11 eV and 1.83 eV respectively. Specimens aged at different temperatures for varying times t, were viewed in the electron microscope. The observations indicate that the precipitate diameter varies as $(K_2t)^{\frac{1}{3}}$, where K_2 is the growth rate constant. (auth)

1198 ATOMIC MECHANISM OF THE POLYMORPHIC TRANSFORMATION OF GROUP IV TRANSITION METALS. Samsonow, G. W. (AN Ukrainskoj SSR, Kiev. Inst. Problem Materialovedeniya). Z. Metallk.; 65: No. 8, 565-567(Aug 1974). (In German).

The $\alpha-\beta$ polymorphic transformation of titanium, zirconium and hafnium results from an increase in the degree of localization of the valency electrons upon heating when the threshold value of 60% required for the formation of the bcc structure is attained. The $\alpha-\beta$ transformation temperature of the group IV transition metals is increased by adding a donor component; it is decreased by adding acceptors which lead to a relative increase of the degree of localization of the valency electrons of these metals. (auth)

1199 INTERNAL STRESSES IN THE $\alpha-\alpha'$ PHASE TRANSITION OF COHERENT METAL-HYDROGEN SYSTEMS. Burkhardt, T. W. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Festkoerperforschung). Z. Phys.; 269: No. 3, 237-240(1974).

In an $\alpha-\alpha'$ phase transition of the type discussed by Wagner and Horner, the smoothly varying hydrogen distribution generates coherency stresses in metal crystal. The system is in a metastable state, which is expected to have a long lifetime if the internal stresses are smaller than some critical stress for destroying coherency. A comparison of the calculated internal shear stress with the experimental value of the critical shear stress for the onset of plastic deformation in a Nb crystal suggests that there may well be an appreciable region in which a coherent transition is experimentally observable. (auth)

1200 USTALOST' I VYAZKOST' RAZRUSHENIYA METALLOV. (Fatigue and Ductility of the Rupture of Metals. Sixth Conference on Metal Fatigue, Moscow, USSR, June 1972). Ivanov, V. S. (ed.). Moscow; Izdatel'stvo Nauka (1974). 263p. (CONF-7206104-).

From 6th conference on metal fatigue; Moscow, USSR (Jun 1972).

Eighteen articles on the use of linear mechanics criteria and the theory of similarity for the prediction of the mechanical properties of metals and alloys, on fracture during cyclic stress, on fatigue curves, and on the effect of the stress rate in cyclic tests were compiled. A separate abstract was written for one of the articles. (tr-auth)

For an abstract of an individual paper see: 1201.

1201 CHARACTERISTICS OF THE FRACTURE OF MOLYBDENUM UNDER FATIGUE CONDITIONS. Ivanova, V. S.; Goritskii, V. M.; Teren'ev, V. F.; Savitskaya, E. E. pp 192-199 of Ustalost' i Vyazkost' Razrusheniya Metallov. Ivanov, V. S. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian)

From 6th conference on metal fatigue; Moscow, USSR (Jun 1972). See CONF-7206104-.

The metallographic characteristics of the origin and propagation of fatigue rupture in polycrystalline Mo were studied by optical and scanning electron microscopy. It was shown that the durability of Mo is basically determined by the duration of the origin of fatigue rupture. The propagation of the rupture proceeds exclusively along the grain boundary. (tr-auth)

1202 RELATIONS ENTRE DEFORMATION PALSTIQUE ET TRANSFORMATIONS DE PHASE. 14 eme Colloque de Metallurgie, Organise a Saclay les 29 et 30 Juin 1971. (Relations Between Plastic Deformation and Phase Transformations. Fourteenth Colloquium on Metallurgy, Saclay, France, June 29-30, 1971). Gif-sur-Yvette, France; Centre d'Etudes Nucleaires de Saclay (1971). 357p. (CONF-710672-).

The 18 papers presented at the conference are compiled. The subjects discussed include matensitie transformations, carbide precipitations, effects of predeformations, martensite structures, decomposition of solid solutions, plastic deformations, effects of interstitial elements, internal damping, and use of Moessbauer spectroscopy. Separate abstracts were prepared for two papers. (JSR)

For abstracts of individual papers see: 1203 and 1204.

1203 INFLUENCE OF A PREDEFORMATION ON THE AGING BEHAVIOR OF MARTENSITE AND FERRITIC PHASES OF A STEEL WITH 0.07% C, 15% Cr, 7 % Ni, 2 % Mo, and 1 % Al. Haudin, J. M.; Frade, G. (Ecole National Superieure des Mines, Paris). pp 139-150 of Relations Entre Deformation Palstique et Transformations de Phase. Gif-sur-Yvette, France; Centre d'Etudes Nucleaires de Saclay (1971). (In French)

From 14th colloquium on metallurgy relations between plastic deformation and phase transformations; Saclay, France (29 Jun 1971). See CONF-710672-.

When an austeno-martensite steel containing ferrite and martensite phases is aged between 450 and 600°C, several types of precipitation appear in these two phases and affect the mechanical behavior of the material. During prolonged tempering, the martensite is reverted into the austenite and other precipitates appear at martensite-austenite interfaces. The effect of a predeformation of the martensite and the ferrite on the processes for the appearance and evolution of the precipitation during aging was determined. The identification and location of these precipitates by electron microscopy and by measurements of the mechanical characteristics made it possible to interpret the hardening mechanisms and to define the treatments which give the optimum mechanical properties for this steel. (tr-auth)

1204 INFLUENCE OF INTERSTITIAL (OXYGEN) AND SUBSTITUTIONAL (IRON) ELEMENTS ON THE AGEING AFTER DEFORMATION (STRAIN AGEING) AT VARIOUS TEMPERATURES OF SLIGHTLY ALLOYED ZIRCONIUM. de Paula e Silva, E.; Com-Nougue, J.; Beranger, G.; Lacombe, P. (Ecole National Superieure des Mines, Paris). pp 269-290 of Relations Entre Deformation Palstique et Transformations de Phase. Gif-sur-Yvette, France; Centre d'Etudes Nucleaires de Saclay (1971). (In French)

From 14th colloquium on metallurgy relations between plastic deformation and phase transformations; Saclay, France (29 Jun 1971). See CONF-710672-.

An ageing treatment after deformation of Zr slightly charged with substitutional (Fe) or interstitial (O_2) elements causes the appearance of a discontinuity on the strain curve. The effect of some factors on this phenomenon of ageing-induced hardening was studied, particularly ageing, duration and temperature, oxygen content, content of substitutional elements, stress occurring under ageing and the Zr grain size. For example in the case of Kroll Zr, the phenomenon is maximum for a temperature close to 300°C. The discontinuity decreases in importance when the purity of the material increases. Results suggest a blocking of the dislocations by the interstitial elements, especially oxygen. On the contrary for high contents in oxygen (2700×10^{-6}) the discontinuity disappears. The experimental results are discussed in terms of various mechanisms for the blocking of dislocations. An interpretation based on the existence of a Snoek effect explains the results obtained. (tr-auth)

1205 EFFECT OF INTERFACIAL REACTION ZONE ON TENSILE STRENGTH OF TUNGSTEN FIBER-REINFORCED COPPER ALLOY COMPOSITES. Umakoshi, Y.; Nakai, K.; Yamane, T. Met. Trans.; 5: No. 5, 1250-1251(May 1974).

In Cu-Ni/W and Cu-Mn/W composites a positive contribution of the reaction zone to the longitudinal tensile strength of the fiber-reinforced composites has been observed. It is shown that an improvement in the apparent tensile strength of the fibers can be achieved by annealing for a period of time corresponding to the critical thickness of the reaction zone. The improvement may be attributed to an increase in strength of the interface. As the degree of reaction increases, the strength decreases rapidly. No significant change in the transverse tensile strength was observed. (Metals Abstr.)

1206 EXPERIMENTAL INVESTIGATION OF THE COMPLEX OF THERMAL PROPERTIES OF SOME RARE EARTH METALS AT HIGH TEMPERATURES. Banchila, S. N.; Filippov, L. P. Inzh.-Fiz. Zh.; 27: No. 1, 68-71(Jul 1974). (In Russian).

Heat capacity, thermal diffusivity, and thermal conductivity measurements on liquid La, Pr, and Dy from 1200 to 2000°K are presented. Changes occurring in these parameters on melting are discussed. (auth)

1207 PREPARATION AND STRENGTH PROPERTIES OF A COPPER–TUNGSTEN FIBRE COMPOSITE MATERIAL. Havalda, A.; Taborsky, L.; Ivan, J.; Mauer, J.; Sebo, P. Kovove Mater.; 11: No. 6, 717-725 (1973). (In Czech).

The problems connected with the production of a composite material containing Cu matrix and 0.02 – 1 mm W fibers (only the 0.2 mm fibers were used for measurements as the best results were obtained with them) were studied, and the mechanical and physical properties were measured. The fibers were cleaned electrolytically and cast with molten Cu in vacuum at 1150 to 1200°C. The ceramic mold used for the casting operation is illustrated. The effect of annealing temperature (0 to 1200°C) on strength was measured and plotted. The strength of the material cast in ceramic and graphite molds was also measured and plotted as a function of the W fiber content (5 to 100%). Ceramic mold gave the better results; fiber embrittlement was found in products from the graphite mold. (Metals Abstr.)

1208 PRETSIZIONNYE SPLAVY. (Precision Alloys). Molotilov, B. V. Moscow; Metallurgiya (1974). 448p.

Classifications of precision alloys are given and the areas for the utilization of these alloys are indicated. The extensive materials on the chemical composition, grades, magnetic and physical properties, structure, and technological characteristics are generalized and systematized. The alloys discussed are the easily magnetized and the hard to magnetize alloys, alloys with high Ohmic resistance, alloys with special thermal and elastic properties, superconducting alloys, and thermobimetals. The dependence of the property on the various conditions of processing and testing is reported. (tr-auth)

1209 ULTRASONIC ABSORPTION IN THE NORMAL AND SUPERCONDUCTING STATES OF TIN AND INDIUM. Mahajan, S. K.; Mukerjee, A. K.; Chaudhuri, K. D. (Univ. of Delhi, New Delhi). Indian J. Pure Appl. Phys.; 12: No. 5, 343-349(May 1974).

The absorption of compressional ultrasonic waves was measured in single crystals of spectroscopically pure tin and indium in the temperature range 4.2 to 1.3°K and in the frequency range 3 to 50 MHz. The results were analyzed to calculate the electronic contribution to the total attenuation, mean free path and the effects of strain on the attenuation. The measurements taken in the normal state in the case of pure tin and indium were compared with values predicted by Pippard's theory giving a fairly good fit within the experimental error. The longitudinal normal state attenuation remained constant with decreasing temperature below the critical temperature but the attenuation in the superconducting state was found to be very much dependent on the physical state of the specimen; also strain plays a dominant role. The results indicate that the presence of strain in the single crystal specimen can profoundly affect the behavior of ultrasonic attenuation in superconductors. (auth)

1210 DENSITY AND SURFACE TENSION OF Fe–Si–Cr ALLOYS. Puzyrev, A. V.; Stroganov, A. I.; Povolotskii, D. Ya.; Ryss, M. A.; Zaiko, V. P. Izv. Vyssh. Ucheb. Zaved., Chern. Met.; No. 7, 68-70 (1973). (In Russian).

Density (ρ) and the surface tension (σ) measurements of liquid Fe–Si–W and Fe–Si–Cr alloys were carried out by the method of maximum bubble pressure in the range of 1400 to 1800 °C in pure Ar. Corundum capillaries 5 mm in dia were used and the metal was melted in a Tammans' furnace. The error in σ was ±4% and in ρ ±6%. With rising temperature σ as well as ρ decreased linearly as in the case of pure Fe. (Metals Abstr.)

1211 ACTIVITY COEFFICIENTS OF THE COMPONENTS IN THE TERNARY INDIUM–BISMUTH–ANTIMONY SYSTEM. Mamedov, A. N.; Kuliev, A. A.; Abbasov, A. S. Izv. Akad. Nauk Azerb. SSR, Ser. Fiz.-Tekh. Mat. Nauk; No. 3, 144-148 (1973). (In Russian).

The thermodynamic properties of a series of In–Bi–Sb solid solutions were studied by the emf method, using a concentration cell of the –In | InCl, KCl–LiCl | [$In(N_{In})$–$Bi(N_{Bi})$–$Sb(N_{Sb})$](liquid) type, special attention being paid to the activity coefficient of the constituent elements. Starting from a particular concentration of any of the components, the activity coefficient of the other components approached those operative in the corresponding binary system. The partial displacement of Sb by Bi from the structural groupings of InSb in the alloys led to a sharper increase in the activity of Sb as compared with that of In. (Metals Abstr.)

1212 NMR IN INTERMETALLIC COMPOUNDS OF ALUMINUM WITH RARE EARTHS. Niculescu, V. (Univ. Babes-Bolyai, Cluj). Stud. Cercet. Fiz.; 25: No. 5, 517-545 (1973). (In Rumanian).

Sections are included on NMR in metals and alloys; preparation and crystalline structure of the samples; NMR measurements; magnetic susceptibility measurements; NMR and magnetic susceptibilities of $CeAl_x$ compounds; electronic structure and magnetic properties of aluminium; magnetic behavior of the $CeAl_x$ compounds; measurements of susceptibility; NMR line shape in $CeAl_x$ compounds; Knight shift of ^{27}Al in $CeAl_x$ compounds; NMR and magnetic susceptibility studies in $Ce_xR_{1-x}Al_2$ pseudobinary alloys; magnetic behavior of the $CeY_{1-x}Al_2$ and $Ce_xLa_{1-x}Al_2$ compounds; magnetic behavior of the $Ce_xGd_{1-x}Al_2$ compounds; and magnetic behavior of $Ce_{0.05}Tb_{0.95}Al_2$ and $Ce_{0.975}Er_{0.025}Al_2$ compounds. (auth)

1213 OPTICAL PROPERTIES OF Gd, Dy, AND Tb. Erskine, J.L.; Blake, G.A.; Flaten, C.J. (Department of Physics, University of Washington, Seattle, Washington 98195). J. Opt. Soc. Am. 64: No. 10, 1332-1335 (Oct 1974).

Optical constants in the spectral range 1.5–5.5 eV are presented for the heavy rare–earth metals Gd, Tb, and Dy. The samples are thin films prepared by vacuum evaporation at pressures below 10^{-9} torr, and are studied in situ using a precision ellipsometric technique. The optical spectra are broadly similar but differ slightly in their temperature dependence. The optical data complement recent magneto–optic spectra, and the significance of their difference is discussed in terms of existing electronic–structure models and the microscopic origin of the two spectra. (auth)

1214 OBSERVATION OF THERMAL FLUCTUATIONS IN SUPERCONDUCTING MICROBRIDGES. Rachford, F.J.; Huang, C.Y. (Department of Physics, Case Western Reserve University, Cleveland, Ohio 44106); Nisenoff, M.; Wolf, S. Phys. Rev. Lett. 33: No. 11, 641-644 (9 Sept 1974).

Thermal fluctuations of the type described by Langer and Ambegaokar and by McCumber and Halperin have been observed in superconducting thin–film rings containing microbridge sections. A peak in the fluctuation rate was found near the transition temperature. The temperature dependence of the observed rates is in agreement with the McCumber–Halperin fluctuation–rate equations and the deduced parameters are consistent with the theory. (auth)

1215 CRYSTAL FIELDS IN DILUTE RARE–EARTH METALS OBTAINED FROM MAGNETIZATION MEASUREMENTS ON DILUTE RARE–EARTH ALLOYS. Touborg, P.; Høg, J. (Department of Electrophysics, Technical University, DK–2800 Lyngby, Denmark). Phys. Rev. Lett. 33: No. 13, 775-778 (23 Sept 1974).

Crystal field parameters of Tb, Dy, and Er in Sc, Y, and Lu are summarized. These parameters are obtained from magnetization measurements on dilute single crystals, and successfully checked by a number of different methods. The crystal field parameters vary unpredictably with the rare–earth solute. B_{40}, B_{60}, and B_{66} are similar in Y and Lu. Crystal field parameters for the pure metals Tb, Dy, and Er are estimated from the crystal fields in Y and Lu. (auth)

1216 MAGNETIC PROPERTIES OF Ho–Co AND Ho–Fe AMORPHOUS FILMS. Heiman, N.; Lee, K. (IBM Research Laboratory, San Jose, California 95193). Phys. Rev. Lett. 33: No. 13, 778-781 (23 Sept 1974).

Polar–Faraday–rotation and magnetization measurements on evaporated amorphous films of Ho–Co and Ho–Fe show that the principle mechanism responsible for differences in the T_C of the crystalline and amorphous states is the altered electronic configuration of the transition metal, rather than local anisotropy. Additionally we found that the films possess uniaxial anisotropy. (auth)

1217 EFFECTS OF Sn CONCENTRATION ON THE CRITICAL CURRENT DENSITY OF Nb_3Sn FORMED AT THE Nb–(Cu–Sn ALLOY) INTERFACE. Suenaga, M.; Horigami, O.; Luhman, T.S. (Division of Metallurgy and Materials Science, Brookhaven National Laboratory, Upton, New York 11973). Appl. Phys. Lett. 25: No. 10, 624-627 (15 Nov 1974).

Critical current densities J_c (4 T) were measured for Nb_3Sn formed by heat treating at 700 °C composite wires of single–core Nb in various Cu–Sn alloy matrices. For given thicknesses of the Nb_3Sn layers J_c increased with increasing Sn concentration in the matrix up to the single–phase limit of Sn in Cu. Sn concentrations in excess of 8 at.% exceed the solid solubility limit of Sn in Cu at 700 °C, and the J_c of the Nb_3Sn formed when the composite is heat treated is an order of magnitude less than the J_c obtained for those samples whose Sn content is within the single–phase limit. The highest J_c (4.0 T) was $\sim 1.8\times10^6$ A/cm² for a 1–μm Nb_3Sn layer formed in a 25–mil wire with a Cu–Sn matrix composition of 7.5 at.% (13 wt%) Sn. (auth)

1218 PROBING THE SUPERCONDUCTING VORTEX STRUCTURE BY POLARIZED–μ^+ SPIN PRECESSION. Fiory, A.T.; Murnick, D.E.; Leventhal, M. (Bell Laboratories, Murray Hill, New Jersey 07974); Kossler, W.J. Phys. Rev. Lett. 33: No. 16, 969-972 (14 Oct 1974).

The magnetic field structure of vortices in the mixed state of a lead–indium alloy and of niobium was probed by stopped μ^+ particles. Fourier transforms of time–dependent spin–precession data contain a peak at the average internal field, which is also the applied field. For the alloy only there is a second peak at the saddle point of the internal

field distribution. Motional averaging due to quantum diffusion of the muons at low temperatures can account for these results. (auth)

1219 CHARGE FLUCTUATIONS AND LOCAL-ENVIRONMENT DEPENDENCE OF THE ENERGY OF THE 4f VIRTUAL LOCALIZED LEVEL OF Eu IN $Eu_x La_{1-x} Rh_2$. Bauminger, E.R.; Felner, I.; Levron, D.; Nowik, I.; Ofer, S. (The Racah Institute of Physics, The Hebrew University, Jerusalem, Israel). Phys. Rev. Lett. 33: No. 15, 890-893 (7 Oct 1974).

The recoilless-absorption spectra of the 21.6-keV γ rays of Eu^{151} in $Eu_xLa_{1-x}Rh_2$ are composed of a few lines which exhibit strongly temperature-dependent isomer shifts. The results are interpreted in terms of fast fluctuations of electrons between a localized 4f level and the conduction band. The energy released by removing an electron from the 4f level to the conduction band (0.01-0.1 eV) depends siginificantly on the number of La nearest neighbors. The levels have a width of ~0.01 eV. (auth)

1220 SUPERCONDUCTIVITY OF POLAR SEMICONDUCTORS AND SEMIMETALS. Pashitskii, E.A.; Makarov, V.L.; Tereshchenko, S.D. (Institute of Physics, Academy of Sciences of the Ukrainian SSR, Kiev, T.G. Shevchenko, Kiev State University). Sov. Phys.-Solid State 16: No. 2, 276-281 (Aug 1974).

A theoretical examination is made of superconductivity in many-valley (many-band) polar semiconductors and semimetals with considerably different effective masses and free-carrier densities in different valleys (bands), and a numerical solution of the nonlinear integral equation for the gap in the energy spectrum of degenerate "light" carriers is obtained, taking into account the integration of the latter with both longitudinal optical phonons and with low-frequency collective oscillations of "heavy" carriers (acoustic plasmons). It is shown that the gap Δ, and hence the critical temperature T_c for the superconducting transition, increase monotonically with increasing carrier density and increasing pressure, which is in qualitative agreement with the experimental results for the semiconductor compounds GeTe and SnTe, for the rare-earth chalcogenides La-S and La-Se, and also for semimentals such as Bi. (auth)

1221 KINETIC PROPERTIES OF TERBIUM, DYSPROSIUM, HOLMIUM, AND ERBIUM AT HIGH TEMPERATURES. Zinov'ev, V.E.; Gel'd, L.P.; Chuprikov, G.E.; Moreva, N.I. (S. M. Kirov Ural Polytechnical Institute, Sverdlovsk, State Institute of the Rare-Metal Industry, Moscow). Sov. Phys.-Solid State 16: No. 2, 235-236 (Aug 1974).

The electrical resistivity (from 290 to 1200°K) and the thermal diffusivity (from 700 to 1400°K) of pure terbium, dysprosium, holmium, and erbium have been investigated; values for the thermal conductivity of these metals above 700°K have been obtained by using data available in the literature. The mechanisms of carrier scattering at high temperature are analyzed. (auth)

1222 SATURATION MAGNETIZATION OF GADOLINIUM-LANTHANUM ALLOYS IN RANGE 77-240°K. Beznosov, A. B.; Nazarenko, V. G. (Physicotechnical Institute of Low Temperatures, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.-Solid State (Engl. Transl.); 16: No. 2, 372-373(Aug 1974).

The magnetic properties of Gd-La alloys having a composition of 0 to 10 wt % La were studied to gain information on the nature of the exchange interaction in 4f metals. The temperature dependence of the saturation magnetization of the samples was measured using a pulsed magnetic field generator provided with a thermostat. Experimental results are tabulated, and it was found that in the temperature interval from 77°K up to higher temperatures (ranging from 185 to 240 for various samples) the magnetization of all samples follows the Bloch law. Using the experimental data, exchange interactions between neighboring Gd ions were calculated. (SFL)

1223 CRYSTALLIZATION PROCESSES IN THIN FILMS OF TRANSITION METALS. Palatnik, L. S.; Obol'yantsnova, O. A.; Naboka, M. N.; Gladkikh, N. T.; Khotkevich, V. I. pp 209-217 of Kinetika i Mekhanizm Kristallizatsii. Sirota, N. M. (ed.). Minsk; Izdatel'stvo Nauka i Tekhnika (1973). (In Russian).

The composition of condensed molecular beams formed in the thermal vaporization of the metals of Groups V and VI was studied by mass spectrometry. A correlation was shown between the composition of the molecular beam and the phase composition of the condensate. The chief impurities were oxide particles, MO and MO_2, the amount of which depended on the vaporization regime. Upon precipitation of a molecular beam containing only metal particles in layers less than 100 Å thick, the metals Nb, Ta, Mo, and W crystallized only in the face-centered cubic phase. With increase in layer thickness there was an allotropic conversion of face-centered cubic to body-centered cubic. In the precipitation of V and Cr, crystallization was in thinner layers (less than 20 Å) with a body-centered cubic structure typical of the massive material. Since the face-centered cubic modifications of Nb and Ta are isostructural with their oxides, the phase analysis of thin films of these metals may be made with simultaneous control of the composition of the condensed molecular beam. In thin films of W made at low condensation rates, the cubic modification of the oxides W_2O_3 and WO_2 was observed first; these are unknown in massive samples. The dimension effect with polymorphic conversion to tungsten oxides is seen at greater thicknesses of condensate with pure metals. (tr-auth)

1224 STUDY OF THE THERMODYNAMIC PROPERTIES OF AN IRON-MOLYBDENUM ALLOY. Bokshtein, B. S.; Bronfin, M. B.; Nikol'skii, G. S. (Moscow Inst. of Steel and Alloys). Izv. Vyssh. Ucheb. Zaved., Chern. Met.; No. 7, 111-113(1974). (In Russian).

By the method of Langmuir, a study was made of the thermodynamic properties of a dilute solid solution of Fe-1.13 at. % Mo at 950 to 1200°C. It is shown that in this dilute solid solution there are negative deviations from Raoult's law which lead to the occurrence of a local near order. (SJR)

1225 USE OF COMPUTERS FOR THE ANALYSIS OF HETEROPHASE DIFFUSION IN TERNARY ALLOYS. Borisov, V. T.; Borisov, V. I.; Shcherbedinskii, G. V. Fiz. Metal. Metalloved.; 38: No. 2, 254-259(Aug 1974). (In Russian).

A program was developed for the calculation of the kinetic growth of diffusion layers during the diffusion saturation of ternary solid solutions. The possibility of one-, two-, and three-phase solution was shown. In the concentration triangle, regions of the three-phase diffusion zones occupy some specific part of the corresponding region of homogeneity of the solid solution. The division line between determinations of the different types depends on the value of the diffusion coefficient in the phases. Particularly, the type of diffusion zone can be altered by change of the composition of the saturated mixture or the annealing temperature. A program was developed for the calculation of the coefficient of diffusion of components in alloys according to the experimental data on the pattern of the concentration curves. Mo-Nb-Cr and Ni-Mo-Al alloys were used as examples. (tr-auth)

1226 ELECTROCHEMICAL INVESTIGATION OF RARE-EARTH METAL AMALGAMS. II. Solubility of Cerium, Praseodymium, and Neodymium in Mercury. Usenova, K. A.; Osipova, G. V.; Krebaeva, Sh. D.; Enikeev, R. Sh. Sov. Radiochem. (Engl. Transl.); 16: No. 1, 95-99(1974).

Translated from Radiokhimiya; 16: No. 1, 99-103(1974).

The solubility of rare-earth metals which have no stable divalent state in mercury may be determined on the basis of the difference in the kinetic rules of the decomposition of their potentiostatted homogeneous and heterogeneous amalgams in aqueous solutions. At 25°C the solubilities of cerium, praseodymium, and neodymium in mercury are $(6.8 \pm 0.7) \cdot 10^{-2}$; $(2.1 \pm 0.3) \cdot 10^{-2}$; $(1.1 \pm 0.2) \cdot 10^{-2}$ g-atom/liter, respectively. (auth)

1227 ELECTROCHEMICAL INVESTIGATION OF RARE-EARTH METAL AMALGAMS. III. Solubility of Samarium, Ytterbium, and Europium in Mercury. Usenova, K. A.; Krebaeva, Sh. D.; Osipova, G. V.; Enikeev, R. Sh. Sov. Radiochem. (Engl. Transl.); 16: No. 1, 100-103(1974).

Translated from Radiokhimiya; 16: No. 1, 104-108(1974).

In aqueous solutions heterogeneous amalgams of europium, ytterbium, and samarium preserve the initial value of the potential for a long time; the potentials of homogeneous amalgams of these metals shift toward more positive values from the initial moment of contact with the solutions. On the basis of this rule it was established that at 25°C the solubility of samarium, ytterbium, and europium in mercury (g-atom/liter) equals $(1.0 \pm 0.5) \cdot 10^{-1}$; $(8.8 \pm 0.7) \cdot 10^{-1}$; 1.1 ± 0.1, respectively. In the formation of mixed heterogeneous amalgams of rare-earth metals which have no stable divalent state, metals whose content does not exceed the limit of their solubility in mercury are also included in the solid phase of the amalgams. Europium is not included in the solid phase of heterogeneous amalgams of rare-earth metals which have no stable divalent state. (auth)

1228 INTERACTION OF ALLOYS OF THE NEODYMIUM-BISMUTH SYSTEM WITH HYDROGEN. Antonova, M. M.; Chernogorenko, V. B.; Lynchak, K. A.; Morozova, R. A.; Skolozdra, R. V. (Inst. of Problems in Materials Science, Kiev). Ukr. Khim. Zh.; 40: No. 9, 990-992(Sep 1974). (In Russian).

The behavior of alloys of the Nd-Bi system in H_2 was studied at a pressure of 1 atm. and temperatures up to 1000°. The greatest quantity of H_2 was absorbed at 500°. The alloys containing Nd-based solid solutions and Nd_3Bi absorb the H_2. The amount of H_2 absorbed was reduced with reduction of the metallic Nd and Nd_3Bi concentration in the alloy. Alloys containing only phases based on Nd_5Bi_3, Nd_4Bi_3, NdBi, $NdBi_2$, and Bi did not react with H_2. (tr-auth)

1229 ELECTRON-PHONON INTERACTION IN SIMPLE METALS: BEYOND THE DIFFRACTION MODEL. Perdew, J. P.

(Univ. of Toronto); Vosko, S. H.; Moore, R. A. Can. J. Phys.; 52: No. 14, 1315-1321(15 Jul 1974).

The exact solution to the self-consistent field screening problem presented in a previous paper (Moore et al.), reduces in the weak pseudopotential limit to the diffraction model for the electron–phonon matrix element, and in particular to Animalu's expression for the screening of a nonlocal pseudopotential. Systematic corrections to the diffraction model, including local field effects, are presented for a pseudopotential of moderate strength; these corrections are particularly simple when the pseudopotential is local. Local pseudopotential calculations of the anisotropic electron–phonon form factors indicate that corrections to the diffraction model are small in sodium but substantial in lithium. (auth)

1230 SOURCE LABELLING BY COINCIDENCE ROUTING OF ANNIHILATION PULSES. MacKenzie, I. K.; Lichtenberger, P. C.; Campbell, J. L. (Univ. of Guelph, Ont.). Can. J. Phys.; 52: No. 15, 1389-1397(1 Aug 1974).

Doppler-broadened annihilation lines from annealed and deformed aluminum samples were measured simultaneously by a Ge(Li) spectrometer. The spectrum was automatically separated into its components by routing signals from auxiliary NaI(Tl) detectors, using the collinearity of annihilation radiation. This differential mode allowed drift-free measurement of recovery at 300°K over a period of 2 weeks. The binding energy of positrons to edge dislocations in aluminum was determined to be 1.7 ± 0.4 eV. (auth)

1231 CHARACTER OF INTERATOMIC INTERACTION IN ALLOYS OF RUTHENIUM–VANADIUM SYSTEM. Yurtaeva, V. K.; Murav'eva, G. P.; Raevskaya, M. V.; Sokolova, I. G.; Sokolovskaya, E. M. Vestn. Mosk. Univ., Ser. II. Khim.; 15: No. 4, 464-466 (1974). (In Russian).

The probability of formation of stacking faults was studied in the range of vanadium solid solution. The correlation between the stacking faults and the alloy hardness was detected. (auth)

1232 X-RAY STUDY OF INTERMETALLIC COMPOUND $Ta(Co_{0.6}Pt_{0.4})_3$. Statnova, E. A.; Kuprina, V. V. Vestn. Mosk. Univ., Ser. II. Khim.; 15: No. 4, 502-503(1974). (In Russian).

The spacings of unit cell and density of new intermetallic compound $Ta(Co_{0.6}Pt_{0.4})_3$ were determined. (auth)

1233 RELATIVE SENSITIVITY OF THE ANALYSIS BY SECONDARY ION–ION EMISSION METHOD. Vasil'ev, M. O.; Chenakin, S. P.; Cherepin, V. T. (Inst. of Metal Physics, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. A; 751-753(Sep 1974). (In Ukrainian).

The results of the mass-spectrometric study of the secondary ion emission arising from the ion bombardment of pure metals with argon ions are described. The relative sensitivity coefficients for the most abundant isotopes of 45 pure metals are determined. Maximum difference in the coefficients for various metals reaches three orders of the magnitude. This causes the different analysis sensitivity. (auth)

1234 GALLII. Vzaimodeistvie s Metallami. (Gallium. Interaction with Metals). Yatsenko, S. P. Moscow; Izdatel'stvo Nauka (1974). 220p.

The physical and physical chemical properties of solid and liquid metallic Ga and the characteristics of its interactions with metals are described. The structure and properties of the compounds formed and the phase diagrams are given for Ga compounds with Li, Na, K, Rb, Cs, Cu, Ag, Au, Be, Mg, Ca, Sr, Ba, Zn, Cd, Hg, Pr, U, Pu, Al, In, Tl, Ti, Zr, Hf, Si, Ge, Sn, Pb, V, Nb, Ta, As, Sb, Bi, Cr, Mn, Fe, Co, Ni, Pd, and Pt. (JSR)

1235 α–γ TRANSITION IN CERIUM IS A MOTT TRANSITION. Johansson, B. (Foersvarets Forskningsanstalt, Stockholm). Phil. Mag.; 30: No. 3, 469-482(Sep 1974).

The α–γ transition in cerium is considered as a Mott transition. From spectroscopic data it is concluded that the intra-atomic interaction, U, is considerably smaller than seems to have been believed in the past. Here it is argued that in metallic cerium, U is only of the order of a few electron volts. Current band calculations of the width of a 4f band state are presumably very unreliable, and correlation effects on the ionic crystal potential are probably of considerable importance. Still, some conventional band calculations seem to imply a width of nearly one electron volt for densities appropriate for the dense α phase in cerium. Several experimental facts on the properties of γ and α cerium lead us to assert that metallic cerium cannot promote its f electron into the (sd) configuration. This is most clearly seen from its cohesive energy properties, and it is shown that if cerium were to attain an $(sd)^4$ configuration, say in the α or α' phase, this would lead to a totally unacceptable behavior of a tetravalent transition metal. Instead we are led to consider the f electrons as undergoing a Mott transition and in view of our findings within the Hubbard picture this is a most likely occurrence. From this conclusion, the remarkable similarity of the properties of the pressure-temperature phase diagram of cerium and individual elements in the actinide series is pointed out. From this it is concluded that the earlier commonly expressed view that cerium, when compressed, becomes a normal tetravalent transition metal is invalid. Instead, high pressure on light rare-earth elements rather converts them into actinide type elements. (auth)

1236 FLUXOID PINNING IN NIOBIUM CONTAINING SMALL AMOUNTS OF YTTRIUM OR GADOLINIUM. Koch, C. C.; Kroeger, D. M. (Oak Ridge National Lab., TN). Phil. Mag.; 30: No. 3, 501-513(Sep 1974).

The fluxoid pinning of niobium containing small amounts of either yttrium or gadolinium (≤2 at. %) was determined by direct current magnetization measurements on specimens in the heavily-deformed, partially-recovered, and recrystallized conditions. Optical and electron microscopy were used to characterize the samples. Magnetic hysteresis of Nb was increased by the additions of Y or Gd. In the cold-worked condition increased pinning was due to planar sheets and stringers of Y(Gd) produced by the deformation parallel to the fluxoid axes. The fluxoid pinning was a function of Y(Gd) concentration. In the recrystallized samples the high-angle grain boundaries were the most important pinning sites and the pinning was independent of Y(Gd) content. The Y(Gd) enhanced the pinning effectiveness of grain boundaries by: inhibiting grain boundary migration and thus increasing the grain boundary surface area (decreasing grain size); and reducing preferred orientation in the recrystallized state thus providing greater average grain misorientation, which for Nb with its anisotropic superconducting parameters (π) produces an additional pinning effect. (auth)

1237 GROWTH OF TENSILE AND FATIGUE CRACKS IN METAL FOILS. Alic, J. A. (Wichita State Univ., KS); Asimow, R. M. Eng. Fracture Mech.; 6: No. 2, 223-230(Sep 1974).

The extension of cracks in thin foils of copper, brass, and tantalum was investigated for both monotonic and cyclic loading using optical microscopy and scanning electron microscopy. Crack growth in both tension and fatigue is found to occur primarily by a void coalescence mechanism. The particular morphology of void formation exhibited by a given material is determined by its purity level and stacking fault energy, the latter being important as it affects the slip character—varying from planar to wavy—of the metal. Fatigue crack growth without void formation has also been observed in brass and tantalum. The resulting fracture surfaces are flat; a different growth mechanism, attributed to plane strain conditions at the crack tip rather than plane stress, accounts for this mode of propagation. (auth)

1238 COMPARISON OF SEVERAL FATIGUE CRACK PROPAGATION LAWS WITH EXPERIMENTAL RESULTS. Schwalbe, K. H. (Univ., Karlsruhe, Ger.). Eng. Fracture Mech.; 6: No. 2, 325-341(Sep 1974).

The accuracy of several crack propagation equations published in recent years is tested on crack propagation behavior of fourteen metallic materials, including the steel A 533 Gr. B. Some equations cannot be verified because they contain unknown material parameters. Four equations based on different crack propagation models yield reasonably good approximations of measured behavior. (auth)

1239 MOESSBAUER STUDIES OF ELECTRONIC PROPERTIES OF IRON IMPURITIES IN HEXAGONAL CLOSE-PACKED METALS. Janot, C.; Delcroix, P. (Univ., Nancy). Phil. Mag.; 30: No. 3, 651-661(Sep 1974).

Beryllium specimens containing 0.012 at. % of ^{57}Fe were studied by Moessbauer spectroscopy at various temperatures from 75 to 1200°K. The change of the quadrupole splitting, as a function of the temperature, cannot be explained by the variation of the anisotropy in the host metal. The best fit to the experimental values is obtained by adding a positive constant term and a negative contribution which varies in agreement with a Fermi–Dirac distribution function: $\Delta E_Q(T)_{mm/sec} = 0.288 - 0.910/(1 + \exp - \mu/kT)$. These results are consistent with the existence of localized atom impurity states. The localized state position below the Fermi level, its width, and the density of states at the Fermi level are evaluated. It is found that there are between 5 and 6 d-electrons on each iron atom. Similar conclusions can be obtained about electronic properties of iron impurity in other normal hexagonal close-packed host metals (Mg, Zn, Cd), but results are quite different in transition hexagonal close-packed metals (Cl, Ti, Sc, Zr, ...) where there do not appear to be any localized electronic states. (auth)

1240 EFFECT OF STRUCTURE ON THE CRITICAL CURRENT DENSITY OF Ti–Nb–Ta ALLOYS. Bychkov, Yu. F.; Vozilkin, V. A.; Uzlov, V. Yu. (Moscow Engineering-Physics Inst.). Fiz. Metal. Metalloved.; 38: No. 2, 295-302(Aug 1974). (In Russian).

The critical current density of the superconducting alloys of

the Ti–Nb–Ta system in different structural states was studied. The change of i_c during change of the structure is explained on the basis of the concept of an immobilization of the magnetic current lines at the boundary of the block. (tr-auth)

1241 SUPERCONDUCTING PROPERTIES OF Nb–Al ALLOYS WITH BCC LATTICES. Pan, V. M.; Latysheva, V. I.; Khusid, E. N.; Dekhtyar, I. Ya.; Mikhalenkov, V. S. (Inst. of Metal Physics, Kiev). Fiz. Metal. Metalloved.; 38: No. 2, 303-309(Aug 1974). (In Russian).

It was shown that in solid solution of Al in Nb with bcc lattice the critical temperature T_c decreased by a linear law (~0.24°K/at. %) but the critical field H_{c2} (4.2°K) has a maximum of around 22 kOe at ~7.5 at. % Al. From data obtained by methods of positron annihilation and measurement of the specific resistivity, the values of the concentration of conduction electrons and the free path length were calculated. The change of T_c as a function of the composition is determined probably in the basic character of the phonon spectra. The values of H_{c2} calculated for solid solutions of Al in Nb agree satisfactorily with experimental data. (tr-auth)

1242 PHASE TRANSITION IN THE TITANIUM ALLOY VT22. D'yakova, M. A.; Kaganovich, I. N.; Zvereva, Z. F.; Shklyar, R. Sh.; Efimova, M. V.; L'vova, E. A.; Potemkina, T. G.; Mel'nikova, V. I. (Ural Polytechnical Inst., Sverdlovsk, USSR). Fiz. Metal. Metalloved.; 38: No. 2, 376-382(Aug 1974). (In Russian).

The kinetics of the phase transformations in the Ti alloy VT22 (4.52% Al, 5.8% Mo, 4.84% V, 1.0% Fe, 1.04% Cr, 0.14% Si) were studied. Change of the mechanical and physical properties of the alloy was investigated. (tr-auth)

1243 STUDY OF THE DIFFUSION OF OXYGEN IN Nb USING THE ^{18}O ISOTOPE. Fedorov, G. B.; Fetisov, G. V.; Skakun, N. A.; Khar'kov, O. N.; Arakelov, A. G.; Kissil, A. E. (Moscow Engineering-Physics Inst.). Fiz. Metal. Metalloved.; 38: No. 2, 361-365(Aug 1974). (In Russian).

The diffusion of O_2 in Nb was studied using the nuclear reaction $^{18}O(p,\alpha)^{15}N$. Diagonal slices were used to measure the distribution of the O_2 according to the depth of the diffusion zone. The temperature dependence of the diffusion coefficient was determined in the temperature interval from 400 to 800°C. Results were compared with data obtained by the internal friction method. (tr-auth)

1244 LOW TEMPERATURE STRENGTHENING OF GROUP VA METAL SINGLE CRYSTALS BY HYDROGEN. Chen, C. C.; Arsenault, R. J. (Univ. of Maryland, College Park). Contract AT(40-1)-3612. pp 393-406 of Hydrogen in Metals. Bernstein, I. M. (ed.). Metals Park, OH; American Society for Metals (1974).

From international conference on hydrogen in metals: effect on metal properties, selection, and design; Champion, Pennsylvania, USA (23 Sep 1973). See CONF-730922-.

An investigation was undertaken to determine the influence of hydrogen on the low temperature deformation characteristics in high purity vanadium, niobium, and tantalum single crystals in the temperature range from 20 to 473°K. The experimental approach involved a determination of the change in yield stress, strain rate sensitivity, and yielding behavior as a function of temperature for various hydrogen concentrations. In the presence of hydrogen, the Group Va metals exhibit a local discontinuity in the temperature dependence of yield stress. On the basis of the experimental observations and the analysis of the activation parameters, the low-temperature deformation process controlling the local discontinuity is shown to be a thermally activated process. The major contribution to the low-temperature strength of Group Va metal–hydrogen crystals is attributed to the stress-induced reorientation of hydrides as a result of the stress fields of moving dislocations. (auth)

1245 SOME MAGNETIC PROPERTIES OF SINGLE CRYSTALS OF VARIOUS RFe_2 MATERIALS. Schroeter, J. P. Houston, TX; Rice Univ. (1974). 159p. University Microfilms Order No. 74-21,328.

Thesis (Ph. D.).

Single crystal growth was induced in arc-cast polycrystals of $ErFe_2$ and $Er_{.314}Tb_{.686}Fe_2$ by two techniques. The first, strain annealing of the materials at temperatures 50 to 150°C below the melting point, failed to produce crystals of the requisite size. However, high vacuum zone refining of the arc-cast polycrystals produced crystallites ranging from .1 millimeter to 4 millimeters in diameter. The crystal and phase structure of the zone refined materials was examined by metallographic and X-ray diffraction techniques, and the composition of the materials was analyzed by electronically stimulated X-ray spectroscopic methods. The magnetization of the single crystals was measured using a vibrating sample magnetometer, and the magnetostriction of the single crystals was determined by holographic techniques. A theory is developed for the analysis of the magnetostriction by considering the strain dependence of the magnetoelastic and elastic energy terms in the Hamiltonian of the (cubic) crystal. Using this analysis, the relative magnitudes of the magnetostriction along the single crystal axes and in the polycrystal can be determined. This leads to a prediction of the single crystal magnetostriction in various RFe_2 materials on the basis of observed polycrystalline effects. There is good agreement between theory and experiment. (Diss. Abstr. Int., B)

1246 AMORPHOUS MAGNETIC MATERIALS FOR BUBBLE DOMAIN AND MAGNETO-OPTICS APPLICATION. Cuomo, J. J.; Chaudhari, P.; Gambino, R. J. J. Electron. Mater.; 3: No. 2, 517-529(May 1974).

Magnetic bubble domains were found in rare earth intermetallic systems with GdCo alloys, as an example. Films prepared by sputtering are found to be amorphous with perpendicular anisotropy. The GdCo system will support magnetic domains in a wide variety of compositions and the magnetic bubble domains are readily varied in dia. The use of these amorphous systems is shown to be substrate independent. The amorphous magnetic system is described and domain size variations with film composition are shown. These materials are also useful magneto-optic materials with excellent signal-to-noise characteristics. (Metals Abstr.)

1247 THERMODYNAMICS OF THE LIQUID BINARY IRON–TITANIUM BY MASS SPECTROMETRY. Wagner, S.; St. Pierre, G. R. Met. Trans.; 5: No. 4, 887-888(Apr 1974).

At 1545°C (1818°K) the liquid binary system Fe–Ti is symmetric and regular with the integral excess Gibbs energy and the integral enthalpy of mixing ≃–9700 cal (–40,600 J) $x_{Fe}\,x_{Ti}$/g-atom referred to the liquid components. (Metals Abstr.)

1248 EFFECT OF DEFORMATION AND ALLOYING WITH CARBON AND ZIRCONIUM ON SOME PROPERTIES OF TUNGSTEN. Panovko, V. M.; Danil'chenko, A. N.; Kosachev, L. S.; Semiletov, S. S. pp 96-99 of Obrabotka Davleniem i Mekhanicheskie Svoistva Tugoplavkikh Metallov i Splavov. Pavlov, I. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

Alloying with C and Zr hardens W and increases to 800°C its recrystallization temperature. Some reduction of the ductility of the hardened W in the deformed state can be connected with the effects of cold working. (tr-auth)

1249 EFFECT OF TEMPERATURE AND REPEATED COMPRESSIONS ON THE STRUCTURE AND MECHANICAL PROPERTIES OF MOLYBDENUM. Moguchii, L. N. pp 104-109 of Obrabotka Davleniem i Mekhanicheskie Svoistva Tugoplavkikh Metallov i Splavov. Pavlov, I. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

Ingots of Mo obtained by the method of vacuum arc fusion were compressed. One-time compressed metal at 1400 and 400°C in casings showed good deformation across the sample; effects of different processes on the structure were not established. After repeated extrusions (total deformation of 95%), the grain was shattered to a high degree, particularly strongly in the case of low-temperature processes. Repeated compression at low temperature, in comparison with processes under the usual conditions, increased the transient resistance of Mo from 75 to 85 kg/mm^2. (tr-auth)

1250 HYPERFINE FIELD AT ^{57}Fe NUCLEI IN THE ITINERANT FERROMAGNET $ZrZn_2$. Nishihara, Y.; Ogawa, S.; Waki, S. (Electrotechnical Lab., Tanashi, Tokyo (Japan). Tanashi Branch). Phys. Lett., A; 48: No. 6, 449-450(29 Jul 1974).

Moessbauer spectra of ^{57}Fe doped in $ZrZn_2$ reveal that iron atoms substitute not the magnetic Zr atoms but Zn atoms. The iron atom has no appreciable magnetic moment. (auth)

Radiation Effects

Refer also to abstracts 2344 and 2374.

1251 (AED-CONF-74-328-015) NUCLEAR MAGNETIC RESONANCE OF NEUTRON ACTIVATED SHORT-LIVED NUCLEI: A METHOD TO STUDY (n,γ)-INDUCED LATTICE DEFECTS. Ackermann, H.; Dubbers, D.; Grupp, M.; Heitjans, P.; Stoeckmann, H. J.; Winnacker, A.; Blackenhagen, P. von. (Heidelberg Univ. (F. R. Germany). 1. Physikalisches Inst.). 1974. 2p. INIS.

From international conference on lattice defects in semiconductors; Freiburg im Breisgau, F. R. Germany (22 Jul 1974).

2 refs. Available from ZAED.

The paper describes the formation of lattice defects by thermal neutron capture, their determination by nuclear magnetic resonance measurements of neutron-activated nuclei, and gives examples of application to semiconductors. (GE)

1252 (CONF-740937-1) ORNL CONTRIBUTION TO THE USAEC/UKAEA BILATERAL FAST REACTOR EXCHANGE MEETING ON FUEL CLAD AND CORE STRUCTURAL ALLOYS. (Oak Ridge National Lab., Tenn. (USA)). 1974. 37p. Dep. NTIS $5.00.

From bilateral fast reactor exchange meeting of fuel cladding and core structural alloys; Harwell, UK (16 Sep 1974).

Samples of type 316 stainless steel were given various combinations of cold-working and thermal-aging treatment before irradiation in EBR-II subassembly X100 and X100A. The bulk of the samples was irradiated at 500 and 600°C although for some heat treatment conditions irradiation temperatures of 400, 450, and 700°C were also included. The maximum fluence was 7.8×10^{26} n/m^2 (>0.1 MeV). Immersion density changes in type 316 stainless steel irradiated in the annealed and 20% cold-worked conditions at 500 and 600°C are listed. It is significant that this heat of type 316 stainless steel exhibits very low swelling even in the annealed condition. Swelling correlations of Brager and Straalsund [J. Nucl. Matl., 46: 134(1973)] predict density decreases of about 5.0 and 2.4% in annealed type 316 stainless irradiated to 6.6×10^{26} n/m^2 (>0.1 MeV) at 500 and 600°C compared with the values of 0.59 and 1.53% observed in this alloy. (auth)

1253 DEFORMATION CHARACTERISTICS OF LOW-TEMPERATURE NEUTRON-IRRADIATED VANADIUM. Chen, C. C.; Arsenault, R. J. (Univ. of Maryland, College Park). Scr. Met.; 8: No. 8, 1015-1024(Aug 1974).

Deformation properties of V single crystals neutron-irradiated at 18°K were investigated. It was found that V irradiation under these conditions causes an increase in the yield strength, serrated yielding, and a reduction in work hardening rate. It appears that free migration of the radioinduced defects are responsible for the changes in yield stress and twinning behavior during post-irradiation annealing. (JRD)

1254 DAMPING AND ELECTRON MICROSCOPY STUDIES OF GAMMA-IRRADIATION ON AGE-HARDENING ALUMINUM ALLOYS. Miura, K. Notre Dame, IN; Univ. of Notre Dame (1974). 122p. University Microfilms Order No. 74-20,563.

Thesis (Ph. D.).

The effect of ^{60}Co γ-irradiation on pure Al and a series of age-hardening Al alloys has been studied by means of dislocation damping measurements and transmission electron microscopy. The γ-irradiation has been conducted in a 10 kilocurie ^{60}Co source at room temperature at a flux of 10^{11} photons/cm^2/s (6×10^3 rad/min). In pure Al and Al–3% Cu–T6, the damping decreases monotonically, and is attributed to the pinning of dislocation by radiation-induced point defects. In 2017–T6, 2024–T6 and Al–10% Mg–T6, an anomalous damping minimum occurs at 4 to 8 hours of irradiation. Electron microscopy studies of pure Al and Al–3% Cu–T6 show that irradiation has no effect on the microstructures. On the other hand, 2017-T6, 2024–T6 and Al–10% Mg–T6 show marked changes in the precipitate morphology during irradiation. The presence of Mg appears to be a key to the observed effects. In order to explain the damping behavior with its accompanying minimum, a model is proposed, and responsible damping mechanisms are discussed. Then, electron microscopy results are discussed as they relate to the damping model and damage mechanism. (Diss. Abstr. Int., B)

1255 ELECTRON IRRADIATION EXPERIMENTS IN GOLD WITH 2.5-MeV ELECTRONS. Ruault, M. O.; Jouffrey, B. (CNRS, Toulouse Cedex, France). Appl. Phys. Lett.; 25: No. 5, 265-267(1 Sep 1974).

Electron irradiations were performed on six nines purity (6N) gold in the 3-MV electron microscope at Toulouse. Partially ordered vacancy tetrahedra were observed in all of the sample while interstitial loops were formed in its thick parts. Investigation of the nature and cause of the ordering are reported. (auth)

1256 STRESS WAVES GENERATED IN THIN METALLIC FILMS BY A Q-SWITCHED RUBY LASER. Yang, L. C. (Jet Propulsion Lab., Pasadena, CA). J. Appl. Phys.; 45: No. 6, 2601-2606(Jun 1974).

Vacuum-deposited thin films of B, C, Mg, Al, Si, Ti, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ge, Zr, Mo, Ag, In, Sn, Sb, Pt, Au, Pb, and Bi in several thicknesses, confined between glass substrates, were irradiated by a uniform Q-switched ruby laser beam. The laser pulse was 15 ns in duration, with a maximum energy of 5 J in an area 6.35 mm in diameter. The stress waves were studied using the piezoelectric response of X-cut quartz-crystal disks of the same diameter. The peak stresses are presented as a function of the energy fluence, with possible interpretations of the phenomenon. (auth)

1257 INCREASED EFFICIENCY OF A DISLOCATION LINE AS A SINK FOR VACANCIES WHEN IT OSCILLATES. Green, W. V.; Weertman, J. (Los Alamos Scientific Lab., NM). Radiat. Eff.; 22: No. 1, 9-13(May 1974).

An analysis is made of the effect of dislocation vibration on the efficiency of a dislocation line as a sink for point defects. It is concluded that a dislocation will act as a better sink whenever the amplitude of vibration λ is larger than the characteristic diffusion distance $d = (D/4\nu)^{1/2}$ where ν is the frequency of vibration and D is the diffusion coefficient of the point defect. Because D is so large for interstitial atoms it is not expected that this effect ever is important for interstitial atoms. The effect can be important for lattice vacancies and can counteract the effect of the stress field of a dislocation that makes a dislocation line a more efficient sink for interstitial atoms than for vacancies. The present theories of void growth in irradiated metals depend on the assumption that dislocation lines are better sinks for interstitials than for vacancies. If these theories are correct, it can be expected that void growth can be prevented by vibrating dislocations over a great enough amplitude at a high enough frequency. (auth)

1258 THE EFFECT OF CLUSTER FORMATION ON THE "TEMPERATURE SHIFT" FOR ACCELERATOR SIMULATION OF NEUTRON IRRADIATION. Straalsund, J. L. (Westinghouse Hanford Co., Richland, Wash. (USA)). J. Nucl. Mater.; 51: No. 3, 302-308(Jul 1974).

The effect of the nature of the incident particles on the temperature dependence of irradiation-induced void formation in steel is considered. During neutron irradiation small clusters of vacancies are formed in spikes. At temperatures below the maximum in the swelling–temperature curve these clusters tend to dissolve slowly and hence provide recombination sites for interstitials as well as vacancies which have escaped from other clusters. Consideration of the dissolution kinetics of these clusters leads to the theoretical prediction of a minimum temperature for void formation (under neutron irradiation) of around 350°C. This result is more consistent with experimental observation than the much lower temperatures predicted by previous theory and hence lends support to the cluster dissolution theory. Due to the nature of the interaction of the high-energy electrons with the lattice, no clusters are formed during HVEM simulation of neutron damage, and cluster dissolution kinetics are therefore not controlling. Clusters are, however, produced in heavy-ion bombardment. Consequently the rate-dependent temperature shifts which are used to compare accelerator void formation data with neutron irradiation are expected to be different for electrons and for heavy ions. (auth)

1259 EFFECT OF MOBILE HELIUM ON VOID NUCLEATION IN MATERIALS DURING IRRADIATION. Wiedersich, H.; Burton, J. J. (Argonne National Lab., Ill. (USA)); Katz, J. L. (Clarkson Coll. of Tech., Potsdam, N. Y. (USA)). J. Nucl. Mater.; 51: No. 3, 287-301(Jul 1974).

The steady-state rate of void nucleation is calculated for irradiated materials containing mobile helium. At the low displacement rates typical of a fast-breeder reactor, a concentration of less than 10^{-10} atom fraction helium can cause a 10^{20} increase in nucleation rate. The helium is less effective at the high displacement rates typical of accelerator experiments, but can increase the void-nucleation rate by 10^4 at a helium concentration of 10^{-8}. The calculated void-nucleation rates for low displacement rates and without helium are too low to explain the void number densities observed in breeder-reactor irradiated materials. Therefore, void nucleation in reactor environments is helium-assisted. Accelerator experiments intended to simulate void nucleation under reactor conditions must be carefully designed to observe gas-assisted rather than homogeneous void nucleation. (auth)

1260 SWELLING RESULTS FROM HELIUM-PRESSURIZED 304L STAINLESS STEEL TUBES. Walters, L. C.; Flinn, J. E. (Argonne National Lab., Idaho Falls, Idaho (USA)). J. Nucl. Mater.; 52: No. 1, 112-114(Aug 1974).

In a previous paper, results were presented from an in-reactor creep experiment on helium-pressurized annealed 304L stainless steel tubes. The measured diameter increase on the pressurized capsules was due to the combined contribution of irradiation-induced swelling and irradiation enhanced creep. A question raised in the original paper was whether the irradiation-induced swelling may be dependent on the applied stress. Recently, two capsules from the experiment were subjected to destructive examination to determine if irradiation-induced swelling was dependent on applied stress for the conditions of in-reactor exposure experienced by the capsules. It was concluded that there was no significant stress dependence for the specific conditions considered. (auth)

1261 SMALL-ANGLE GRAIN BOUNDARIES IN NEUTRON-IRRADIATED Cu–B ALLOY. Hishinuma, A.; Katano, Y.; Shiraishi, K. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). J. Nucl. Mater.; 52: No. 1, 103-111(Aug 1974).

Dislocation networks and small-angle grain boundaries were observed to form among damage shells produced around B particles in B-doped Cu specimens neutron irradiated to a thermal dose of 3.0×10^{19} n/cm^2 at about 70°C. The microstructures are formed as a result of the interaction of dislocations generated by strain induced around a damage shell with dislocations generated from the other damage shell. The small-angle grain boundaries are formed to relax the strain induced between closely spaced damage shells. (auth)

1262 IRRADIATION-INDUCED PLASTIC SETS IN METALS. Lewthwaite, G. W. (UKAEA Reactor Group, Dounreay. Dounreay Experimental Reactor Establishment). J. Nucl. Mater.; 52: No. 1, 123-124(Aug 1974).

Segments of glissile dislocations, anchored by the nodes of a dislocation network, will bow out in their glide planes under the action of an external stress, contributing to the elastic strain and lowering the measured elastic modulus. If, while the stress is applied, the segments are pinned along their lengths, they will be unable to return to their original positions when the stress is released; there will be a consequent plastic strain or set and an increase in the elastic modulus. Irradiation by energetic neutrons is believed to produce defects which can pin otherwise mobile dislocations. For example Thompson et al. suggest that the decrease in internal friction and increase in Young's modulus observed by them in copper following neutron irradiation is due to such pinning. Accordingly it is to be expected that plastic sets would be produced in irradiation-creep and stress-relaxation experiments by this means and indeed such effects have been discovered in experiments with graphite. Some early stress-relaxation tests are analyzed and it is concluded that the effect does occur. (auth)

1263 INERTIA OF THE EROSION OF SOLIDS UNDER PULSED ELECTRON IRRADIATION. Noskov, D. A.; Pankovets, N. G. Elektron, Obrab. Mater.; No. 1, 5-6 (1974). (In Russian).

The erosion of solid materials (metals, glass, and ceramics) under the influence of pulsed electron irradiation is discussed in the light of the latest theoretical and experimental data, special attention being paid to questions of inertia and their relation to the electron-beam parameters. The inertia may best be analyzed by recording the total duration of the escape of particles from the zone of action of the beam, using a photomultiplier system. Such measurements confirm that in the case of most of the materials studied the escape of particles continues for 300 to 900 μs after irradiation has ceased. (Metals Abstr.)

1264 ISOCHRONAL ANNEALING OF PURE LEAD ELECTRON-IRRADIATED AT 1.5 K. Birtcher, R.C.; Lwin, Y.; Koehler, J.S. (Department of Physics and Materials Research Laboratory, University of Illinois, Urbana, Illinois 61801). Phys. Rev. Lett. 33: No. 15, 899-900 (7 Oct 1974).

The low-temperature isochronal annealing of lead after electron irradiation at 1.5 K shows the same discrete annealing steps observed in copper and silver. The major recovery stage (usually labeled I_D) occurs at 4.0 K. (auth)

1265 EFFECT OF NEUTRON IRRADIATION ON THE DECOMPOSITION OF SUPERSATURATED SOLID SOLUTIONS OF Be IN Ni. Grinchuk, P. P.; Loboda, E. M. Fiz. Metal. Metalloved.; 38: No. 2, 329-336(Aug 1974). (In Russian).

The alloy Ni + 2 wt % Be, irradiated in the SM-2 reactor with different neutron doses at T $\simeq$ 70°C, was investigated by transmission electron microscopy, x-ray structural analysis, electric resistivity, and microhardness measurements. It was established that in the original stage of postradiation aging, a significant acceleration of the decomposition of the supersaturated solid solution of Be in Ni occurs with formation of flat Guinier-Preston zones and acceleration of the diffusion processes in the stage of the appearance of metastable precipitates. The radioinduced acceleration of the diffusion processes both in the original stages of decomposition of the solid solution and in the stages of formation of the metastable precipitates increases with the radiation dose. Partial recovery, connected possibly with the dissolution of the unstable Guinier-Preston zone, was observed. (tr-auth)

1266 ANALYSIS OF THE RECOVERY OF DILUTE COPPER ALLOYS AFTER LOW TEMPERATURE ELECTRON IRRADIATION. Cannon, C. P. Salt Lake City; Univ. of Utah (1974). 83p. University Microfilms Order No. 74-23,102.

Thesis (Ph. D.).

The influence of dilute additions of both Au and Ag atoms on the stage I and stage II annealing structure in copper was investigated using electrical resistivity measurements. Agreement of stages I_I and I_E with theoretical predictions of the Simpson-Sosin full diffusion theory is obtained; this analysis determines the capture radius of solute Au atoms in Cu to be 1.7 ± 0.1 l.c. and that of solute Ag atoms in Cu to be 1.8 ± 0.1 l.c. during stage I annealing. Four well-defined recovery substages are observed in the dilute alloys during stage II recovery. An interpretation of each of these substages is presented. The following processes were observed to occur during stage II: release of trapped interstitial atoms from trapping centers formed by the proximity of a dopant atom to a vacancy; rearrangement of trapped interstitials to new trapping positions at impurity atoms; and thermal activation of trapped interstitials from doublet impurity atoms as well as single impurity atoms. (Diss. Abstr. Int., B)

1267 OBSERVATION OF NONCHARACTERISTIC X-RAYS PRODUCED BY Ne^+ BOMBARDMENT OF Al AND Si. Knaf, B.; Presser, G. (Frankfurt Univ. (F. R. Germany). Inst. fuer Kernphysik). Phys. Lett., A; 49: No. 1, 89-90(12 Aug 1974).

Broad x-ray continua ranging from the characteristic energies of the target atoms to a projectile energy dependent high energy limit were measured. They are ascribed to transitions between quasimolecular states of two target atoms. (auth)

Other Materials

Refer also to abstracts 590, 1267, and 2341.

1268 (AD-779612) THERMOELECTRIC PROPERTIES OF INDIUM SELENIDE-BISMUTH SELENIDE SYSTEM ALLOYS. Gukhman, G.; Kostova, M. G.; Nicklova, S. M. Translated from Khim. Ind. (Sofia); No. 7, 1067-1070(1969). 6p.

The coefficient of thermoelectromotive force, the condition, and the thermal condition were determined for In_2Se_3-Bi_2Se_3 alloys as function of the compound and temperature of the thermal treatment. The results confirm the presence of one phase solid solutions over a wide range of Bi_2Se_3 compounds (10-90 mole %). The alloys are semiconductors in the nondegenerative state. The high values of the coefficient of the thermoelectromotive force and the low values of the thermal condition coefficient suggests they can be used in thermoelectric measuring devices. (auth)

1269 (IS-3346(Pt. 2)) COMPILATION OF EXPERIMENTAL WORK ON THERMAL EMITTANCES OF MATERIALS. Part II. Non-Metals. Baria, D. N.; Bautista, R. G. (Ames Lab., Iowa (USA)). Apr 1974. Contract W-7405-eng-82. 351p. Dep. NTIS $10.60.

A compilation of the experimental work on thermal emittances of non-metals reported in the literature through 1972 are presented along with a brief review of the various experimental methods available for thermal emittance determinations. Experimental results reported are tabulated chronologically and appear under the following headings: investigator and year of publication, temperature and wavelength over which work was done, sample specification including composition, preparation method, the experimental method, and error boundaries. (auth)

1270 PURIFICATION OF BORON USING ELECTRON BEAM MELTING. Thevenot, F.; Viala, J. C. (Univ., Lyon). Rev. Int. Hautes Temp. Refract.; 11: No. 2, 155-165(Apr 1974). (In French).

The static melting of boron using electron gun heating enables further purification than vacuum heating. The impurity content is lowered more at the surface (thickness > 200μ) than in the bulk. The purity at the surface of a molten boron sample is higher than that of a zone melted commercial product. The analysis of condensed boron vapors as thin layers agrees with these results and shows that evaporation and condensation of boron are not a true purification. It is however possible to prepare layers with less than 300 mass ppM of metals from molten boron. The floating zone and melting zone methods allow boron crystals in the β rhombohedral form to be obtained and the distribution coefficient of a great number of impurities to be determined. (FR)

1271 ELECTROPLASTIC EFFECT IN INDIUM. Troitskii, O. A.; Gusev, E. V. (Inst. of Physical Chemistry, Moscow). Strength Mater. (USSR) (Engl. Transl.); 5: No. 12, 1476-1479 (Dec 1973).

Translated from Probl. Prochnosti; 5: No. 12, 50-53(Dec 1973).

A study of In crystal creep was conducted at liquid nitrogen temperature under conditions of electron irradiation. It was found that electron irradiation of indium with particle energies below the atom ejection threshold, and electric currents of athermal magnitude applied during low-temperature creep in indium crystals both lead to a lowering of the critical shear stress and increase in the creep rate in the metal. At electron energies above the atom ejection threshold, radiation hardening occurs together with the electron plastification of the metal due to formation of dislocation stoppers such as additional point defects or assemblies of defects. (auth)

1272 PREPARATION OF SOME US-RICH SOLID SOLUTIONS IN THE UC-US SYSTEM. Lovell, G.H.B.; van Tets, A.; Britz, E. J. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). J. Nucl. Mater.; 51: No. 3, 337-342(Jul 1974).

Stoichiometric UC can be quantitatively reacted with the stoichiometric amount of ZnS to yield a mixture of US and C by heating at 800-1000°C in vacuum or inert atmosphere. During the reaction the Zn is liberated as vapor. Intimately blending the US + C mixture with the requisite amount of stoichiometric UO_2 and heating at 1700°C under vacuum results in a reaction between the C and UO_2, $^2/_3$ of the C being evolved as CO, the US under these conditions being inert. The UC formed dissolves in the US to give a solid solution of composition 75 mol % US-25 mol % UC. If desired, UC_2 can be used in place of UC, the initial reaction temperature being somewhat lower. UO_2 can be replaced by another uranium oxide such as U_3O_8. Solid solutions of reduced US content can be prepared by decreasing the amount of ZnS and uranium oxide employed, but attempts to increase the US mol % to over 90 by repeating the process on a 75 mol % US-25 mol % UC solid solution have not been entirely successful. The products obtained were probably solid solutions of US with nearly 10 mol % UC_2 and a small amount of a UOS-UO_2 phase. The results of chemical analysis and examinations by x-ray diffraction and metallurgical techniques are reported. (auth)

1273 GAMMA RADIATION EFFECTS ON METAL ADHESIVE JOINTS. Lison, R. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralinstitut fuer Reaktorexperimente). Schweissen Schneiden; 26: No. 2, 57-61(1974). (In German).

Eight different epoxide gum adhesives were irradiated in an intensive gamma field (approximately 10^8 Roentgen) and then the shearing resistance of the joints was measured, which in most cases had decreased after irradiation. The measuring results gave no information on the creep behavior. (GE)

1274 EFFECTS OF GAMMA-RADIATION ON STRESS RELAXATION OF VULCANIZED RUBBERS. Kusano, T.; Sutoh, Y.; Murakami, K. (Tohoku Univ., Sendai). Nippon Kagaku Kaishi; 1974: No. 6, 1128-1133(Jun 1974). (In Japanese).

Natural rubber vulcanizates which were deformed to variable strains were exposed to γ radiation and their chemorheological properties were examined by the stress relaxation measurements in nitrogen atmosphere. The rate of relaxation decreased with increasing extension ratios. The rate of the degradation which was caused by peroxyradicals produced in the presence of oxygen was too fast to observe the effects on extension ratios. In nitrogen atmosphere the rate of stress relaxation varied in proportion to the extension ratios, and the slope of the proportional constant changed with crosslinking density. Further, the rate of stress relaxation of such vulcanizates seemed to be affected by the crosslinking structures, i.e., peroxide or sulfur crosslinking. Nielsen has reported that the force of contraction was directly proportional to the degree of the orientation of polymer chains. The degree of orientation was inverse proportion to the relaxation rate. Thus, it was suggested that the decrease in rate of degradation in high extension ratios was not caused by the crystallization, but mainly by the orientation of polymer chains. The oriented molecular chains were easily cut by γ-ray irradiation, so-called by mechano-chemical process. The produced macroradicals activated adjacent chains or recombined with other macroradicals. As a result, induced network increased and retarded the stress relaxation in large deformation. (JA)

1275 RADIOACTIVE TRACER STUDY OF DIFFUSION PROCESSES IN LEAD AND SILVER BROMIDE. Williams, S. R.; Barr, L. W. (Paisley Coll. of Tech., Eng.). J. Phys. (Paris), Colloq.; No. 9, 173-177 (1973).

From 1st international conference on lattice defects in ionic crystals; Marseilles, France (2 Jul 1973)

Anion self-diffusion has been studied in $PbBr_2$ and AgBr using an isotope exchange technique. In addition the diffusion of Pb in $PbBr_2$ was measured using ^{210}Pb as tracer and a chemical sectioning method. The effect of bromine gas pressure on anion diffusion was examined for both materials. In the case of $PbBr_2$ these observations were supplemented by ionic conductivity measurements. For $PbBr_2$ the results indicate that the dominant defects are Schottky vacancies with a formation energy of 1.65 eV and an anion mobility energy of 0.31 eV. Interpretation of the results for AgBr is more difficult since the Arrhenius plot of the diffusion coefficient over the range $10^{-17} < D < 10^{-9}$ ($cm^2\ s^{-1}$) shows no clear-cut linear region. The pressure variation of the diffusion coefficient, however, strongly suggests that a single anion vacancy mechanism does not operate to any extent. The kinetics of bromine release during photo-decomposition in UV light has been studied for AgBr and $PbBr_2$. In both cases the kinetics indicate that a diffusion controlled step is rate limiting at long times. (FR)

1276 HIGH TEMPERATURE PROPERTIES AND DECOMPOSITION OF INORGANIC SALTS PART 4. OXY-SALTS OF THE HALOGENS. Stern, K.H. (Electrochemistry Branch, Naval Research Laboratory, Washington, D.C. 20375). J. Phys. Chem. Ref. Data 3: No. 2, 481-526 (June 1974).

The literature dealing with the high-temperature behavior of inorganic oxygen-containing salts of chlorine, bromine and iodine has been critically reviewed. Values of $(G°_T - H°_{298})/T$ of the reactants and products of the decomposition reactions were calculated and have been tabulated from 298 K up to as high a temperature as possible. Equilibrium constants and partial pressure were tabulated. Auxiliary data on phase transitions and densities have also been included. Qualitative information about the thermal decomposition of the salts is reviewed. (auth)

1277 ELECTRICAL PROPERTIES AND NONMETAL-METAL TRANSITIONS IN $Eu_{1-x}Gd_xO$. Samokhvalov, A.A.; Afanas'ev, A.Y.; Gizhevskii, B.A.; Loshkareva, N.N.; Simonova, M.I. (Institute of Metals Physics, Ural Scientific Center, Academy of Sciences of the USSR, Sverdlovsk). Sov. Phys.-Solid State 16: No. 2, 365-366 (Aug 1974).

The electrical conductivity, the thermal emf coefficient, the Hall effect, and the effect of strong electric fields on the conductivity of $Eu_{1-x}Gd_xO$ ($0 \leq x \leq 0.05$) single crystals and polycrystalline aggregates were investigated experimentally. Diagrams showing the temperature dependences of the electrical resistance and thermal emf coefficients for varying values of x in the composition are presented. (SFL)

1278 STUDY OF 2 MeV HELIUM-IRRADIATED PHOSPHORUS-DIFFUSED SILICON. Allen, C. R.; Bicknell, R. W. (Oxford Univ.). Phil. Mag.; 30: No. 3, 483-500(Sep 1974).

2 MeV He^+ ions were used for the location of phosphorus atoms in P-diffused silicon using the Rutherford back-scattering technique. Back-scattered signals from the (110) and (111) directions indicated a very high non-substitutional phosphorus content in the diffusion profile. This was subsequently shown to be produced by the irradiating He^+ ions, which also increased the sheet resistivity correspondingly. Isochronal annealing experiments on the irradiated samples over the temperature range 500 to 1100°K using sheet resistivity and Hall measurements to detect changes in conductivity showed that the conductivity of both high and low phosphorus concentration specimens recovered by a first order process with activation energies of ~0.45 eV and rate constants of ~0.2 sec^{-1}. Examination of the annealed specimens by transmission electron microscopy revealed large triangular pits or voids and prismatic dislocation structures coincident with the projected range of the He^+ ions. Jet etching experiments showed that these voids produced a preferential etch rate which was accurately described by a Gaussian distribution, enabling values of both projected range Rp and projected standard deviation σp for 2 MeV He^+ ions in silicon to be obtained. The annealing characteristics and the activation energies and rate constants have been discussed and shown to be consistent with values which could be produced if the process were a vacancy-controlled mechanism. (auth)

1279 ROTATIONAL ANALYSIS OF THE PH AND PD $A^3\Pi_i - X^3\Sigma^-$ BAND SYSTEMS. Rostas, J.; Cossart, D.; Bastien, J. R. (Paris Univ., Orsay, France). Can. J. Phys.; 52: No. 14, 1274-1287(15 Jul 1974).

PH and PD radicals have been produced in a Schueler type discharge through PH_3 and PD_3. Besides the already known (0-0) bands of PH and PD, new bands, namely the (0-1) band of PH and the (1-0) and (1-1) bands of PD have been photographed in emission, under high resolution. Rotational analyses were performed for these six bands and also for the (1-0) band of PH analyzed earlier by Legay in absorption. The $^3\Pi$ and $^3\Sigma$ states fine structure is interpreted by a simple model, which includes spin-spin, and second-order spin-orbit interactions and also centrifugal distortion effects both on rotational and spin-orbit coupling parameters. The v dependence of the different molecular parameters has been examined and interpreted where possible. (auth)

1280 EXPERIMENTAL STUDY OF INNER SHELL ALIGNMENT OF ATOMS IN ELECTRON IMPACT IONIZATION. Doebelin, E.; Sandner, W.; Mehlhorn, W. (Freiburg Univ. (F. R. Germany). Fakultaet fuer Physik). Phys. Lett., A; 49: No. 1, 7-8(12 Aug 1974).

From a study of the angular distribution of Auger electrons the alignment of the 3d inner shell vacancy of krypton caused by electron impact ionization is shown to be much smaller than that predicted by theory. (INSPEC)

1281 PROJECTILE DEPENDENCE OF K-SHELL IONIZATION IN Cl AND Ca AT 200 keV/amu. Cue, N.; Dutkiewicz, V.; Sen, P.; Bakhru, H. (State Univ. of New York, Stony Brook (USA). Dept. of Physics). Phys. Lett., A; 48: No. 6, 397-398(29 Jul 1974).

Relative K-shell ionization cross sections of Cl and Ca measured with 200 keV/amu singly ionized projectiles of ^2H, ^4He, ^{12}C, ^{14}N, ^{16}O, and ^{20}Ne exhibit features which are adequately de-

scribed by the combination of binding effect in Coulomb ionization and charge exchange to the empty orbitals of the projectile. (auth)

1282 SMALL ANGLE NEUTRON SCATTERING STUDIES OF CONCENTRATION FLUCTUATIONS IN THE NONMETAL TO METAL TRANSITION RANGE: SOLUTIONS OF ^7Li IN ND_3. Chieux, P. (Institut Max von Laue - Paul Langevin, 38 - Grenoble (France)). Phys. Lett., A; 48: No. 6, 493-494 (29 Jul 1974).

Concentration fluctuations were detected in the $^7Li-ND_3$ solutions with significant correlation lengths over a large temperature range. The data follow the classical Ornstein Zernike theory with a marked temperature effect in the temperature range investigated. (auth)

1283 ELECTRON-BEAM DAMAGE IN CATHODOCHROMIC SODALITE. Bhalla, R. J. R. S. B. (American Cyanamid Co., Stamford, CT). J. Appl. Phys.; 45: No. 9, 3703-3709 (Sep 1974).

In recent years sodalite, $Na_8Al_6Si_6O_{24}X_2$, where X is Cl, Br, or I, has received wide attention as a cathodochromic material. The utility of sodalite, however, is severely restricted because of damage produced after repeat write-erase cycles. This damage was investigated and found to be of two kinds. The first kind was considerable loss of potential color centers, i.e., after a certain number of write-erase cycles the material would not color up to the original optical density. The second kind was build up of permanent coloration which could not be removed on exposure to bleaching light but could be removed by heat. Electron microprobe, electron spectroscopy for chemical analysis, thermogravimetric analysis, x rays, and a variety of other analytical tools were used to understand the causes of damage. Considerable loss of sodium and a smaller loss of halogen ions on continued electron-beam irradition was found to be closely associated with the damage. Possibility of heat generated by the electron beam was discounted as the source of damage.

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

1284 (LA-5675-PR) NUCLEAR ANALYSIS RESEARCH AND DEVELOPMENT. Program Status Report, January–April 1974. Keepin, G. R. (Los Alamos Scientific Lab., N. Mex. (USA)). Aug. 1974. Contract W-7405-eng-36. 29p. Dep. NTIS $4.00.

The status of the Nondestructive Assay R & D program of the LASL Nuclear Analysis Research Group for the reporting period is presented. Topics discussed include: small-sample assay of HTGR fuel beads; assay of HTGR fuel rods; performance of the Van de Graaff small-sample assay system; assay of Rover inventory verification samples; investigations into assay techniques for HTGR fuel elements; plutonium isotopic determination by gamma-ray spectroscopy; gamma spectroscopic measurement of plutonium isotopic concentration in the arbitrary sample; discrepancies in plutonium isotopic data; microsphere attenuation in the gamma assay of HTGR fuel materials; field evaluation of low-level assay instrumentation; uranium and thorium monitoring in liquid effluents; automated segmented gamma scan instrument; automated NDA instrument for ^{235}U assay of irradiated Rover fuel; inventory at NRDS; multienergy californium assay system (MECAS); modulated ^{252}Cf assay system, "Shuffler"; PDP-11/20 computer-based gamma-ray assay system upgrading; and PDP-11/05 computer to random driver interface. (TFD)

1285 ESARDA SYMPOSIUM ON R AND D IN THE FIELD OF SAFEGUARDS. Bonalumi, R. (CISE, Milan). Energ. Nucl. (Milan); 21: No. 10, 543-549(Oct 1974). (In Italian).

From Symposium on R and D in the field of safeguards; Rome, Italy (7 Mar 1974).

A brief account of the European Safeguards Research & Development Association (ESARDA) Symposium, on R & D in the field of Safeguards held in Rome on March 7 and 8, 1974 is given. An introductory overview covers the most prominent safeguards-related problems highlighting the Symposium's most significant conclusions. A final section reports on some of the controversial subjects debated at the Symposium outside the formal presentations. (auth)

Disposal and Storage

Refer also to abstracts 180, 354, 522, 830, and 831.

1286 (AEC-tr-7573) WASTE DISPOSAL SYSTEM IN THE NUCLEAR FUEL CYCLE. Wolf; Schmidt, J.; Kuester. Translated from Paper Presented at the Reactor Conference of the German Atom Forum, Berlin, 5 April 1974. (CONF-740468-1). 18p. Dep. NTIS $4.00.

From reactor conference; Berlin, F. R. Germany (2 Apr 1974).

A brief summary is presented concerning the urgency, magnitude and significance of waste disposal tasks for the further development of nuclear technology. Although it is possible to gain the impression from the great number of existing problems that insuperable difficulties exist, solutions for the total system are being found. It should be emphasized that no further time should be wasted. This is especially applicable to the treatment and storage of highly radioactive materials. The possibility of taking engineered storage measures for an intermediate storage ranging from 50 to 100 years and developing appropriate final storage concepts in the meanwhile should insure that even if the very promising storage methods being investigated today should turn out to be unacceptable, alternative concepts can be developed. (auth)

1287 (DP-MS-74-26) LONG RANGE MANAGEMENT OF TRANSURANIUM-CONTAMINATED SOLID WASTES AT SAVANNAH RIVER. Albenesius, E. L.; Reinig, W. C. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1974. Contract AT(07-2)-1. 10p. (CONF-741026-1). Dep. NTIS $4.00.

From seminar on the management of plutonium-contaminated solid wastes; Marcoule, France (14 Oct 1974).

The Savannah River Plant, an 80,000 hectare USAEC production site in the southeastern United States, has generated solid wastes contaminated with 60,000 Ci of transuranium nuclides, chiefly ^{239}Pu, ^{238}Pu, and ^{244}Cm. These wastes, along with 300,000 Ci of transuranium wastes from other AEC sites, are stored in an 80 hectare area on the plant site. A comprehensive planning program to retrieve and convert the wastes to noncombustible and nondispersive forms in preparation for centuries-long storage in an engineered respository is discussed. (auth)

1288 (EURFNR-1204) RADIOACTIVE WASTE MANAGEMENT POTENTIALS AND HAZARDS FROM A RISK POINT OF VIEW. McGrath, P. E. (Kernforschungszentrum Karlsruhe (F. R. Germany)). Jun 1974. 67p. (KFK-1992). Dep. NTIS (U. S. Sales Only) $4.00.

Work performed under United States–Euratom Fast Reactor Exchange Program.

The problems of radioactive waste management are discussed. The magnitude of the problem is identified as primarily concerns the Federal Republic of Germany. Predictions are included of the characteristics of the wastes from the various activities of the nuclear fuel cycle, and their accumulation as a function of time until the year 2010. All important reactor types are considered. The methods for the evaluation of risk are reviewed as well as possible extensions of the methods needed to evaluate risk from radioactive waste management strategies. For input to risk evaluation a hazard index for radioactive isotopes is established and calculated for fuel reprocessing wastes from several reactor types. Proposed waste management strategies are reviewed and their potentials, in terms of risk reduction, are identified. An attempt is made to place the segments of the waste management strategies contributing to risk in perspective. Further effort and a refinement of the work in the area of radioactive waste management evaluation are proposed and outlined. (auth)

1289 (JABE-ARHCO-01) SEISMIC ANALYSIS OF UNDERGROUND WASTE STORAGE TANKS 241-AZ-101 AND -102 AT HANFORD, WASHINGTON. (Blume (John A.) and Associates, Engineers, San Francisco, Calif. (USA)). Apr 1971. 75p. Dep. NTIS $6.75.

For Atlantic Richfield Hanford Co., Richland, WA.

Rigorous dynamic analyses were performed to determine the effects of strong earthquake ground motions on the integrity of 241-AZ tanks which will be used at Hanford for the underground storage of high-level liquid wastes. These seismic analyses are described, and the results presented. No critical overstressing was found in any part of the soil-tank structure for the load conditions which were postulated, i.e., a design basis earthquake whose ground motion would result in a maximum lateral displacement of 1.8 in. at the soil surface. (LCL)

1290 (RT/ING-(74)20) THERMAL TRANSIENTS IN CONTINUOUS MEDIUM IN WHICH RADIOACTIVE WASTES ARE IMMERSED. Part I. Stampone, E. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Jul 1974. 75p. (In Italian). Dep. NTIS (U. S. Sales Only) $6.75.

The first part of the study "Thermal transients in continuous media containing solid radioactive wastes" is presented and concerns bins cooled by a fluid with constant heat transfer coefficient and temperature. Four cases are considered in which the thermal conductivity and diffusivity of the media are temperature dependent. (auth)

1291 (WASH-1538(Draft)(Vol. 1)) WASTE MANAGEMENT OPERATIONS, HANFORD RESERVATION, RICHLAND, WASHINGTON: ENVIRONMENTAL STATEMENT. Volume 1. (USAEC, Washington, D. C.). Sep 1974. 645p. Dep. NTIS $35.25.

A draft environmental impact statement of Hanford Waste Management Operations is presented to evaluate the environmental consequences of past waste management programs using 30-year environmental monitoring data to Jan. 1, 1973 and to assure that future major actions minimize adverse environmental consequences. Information is included on the Hanford site characteristics; unavoidable adverse effects; alternatives; short- and long-term uses of the environment; plans and controls for land use; irreversible and irretrievable commitments of resources; and comparison of costs and benefits. (LCL)

1292 (WASH-1538(Draft)(Vol. 2)(App.)) WASTE MANAGEMENT OPERATIONS, HANFORD RESERVATION, RICHLAND, WASHINGTON: ENVIRONMENTAL STATEMENT. Volume 2. Appendixes. (USAEC, Washington, D. C.). Sep 1974. 842p. Dep. NTIS $45.25.

Maps, descriptions, tabulated and graphic data, process diagrams, etc. are provided as appendix information for the draft environmental statement on the Hanford Waste Management Operations. Information is included on details of the 100 Area, 200 Area, and 300 Area facilities; the demographic and archaeologic data, area geology, seismology, meteorology, hydrology, and ecology, mathematical models and computer codes used for evaluating environmental radiation doses, accident estimation methods, radionuclide inventory of high-level waste in waste tanks and range fire occurrences on the Hanford site. (LCL)

1293 (WASH-1538(Draft)(Vol. 3)) WASTE MANAGEMENT OPERATIONS, HANFORD RESERVATION, RICHLAND, WASHINGTON: ENVIRONMENTAL STATEMENT. Volume 3. (USAEC, Washington, D. C.). Sep 1974. 238p. Dep. NTIS $15.00.

Supplementary material to the draft environmental statement on Hanford Waste Management Operations is provided and includes 213 pages of correspondence to and from the USAEC containing predraft comments and suggestions related to the impact statement, a glossary of terms, and a list of elements. (LCL)

1294 SAFETY ASPECTS AND RISKS IN CONNECTION WITH STORAGE OF WASTE FROM NUCLEAR FISSION. Hamstra, J. (Stichting Reactor Centrum Nederland, The Hague). Atoomenergie Haar Toepass.; 16: No. 7-8, 175-180(Jul 1974). (In Dutch).

High level waste is considered in particular. This waste may be dumped in salt vaults, fixed into glass, or stored in tanks in liquid form or fixed in glass and stored above ground. There are risks associated with all these methods, due to possible unauthorized access; the appropriate solution must depend on local conditions. (NL)

1295 STORAGE OF LONG- AND MEDIUM-TERM RADIOACTIVE WASTE IN A ROCK SALT FORMATION IN HOLLAND. Wervers, H. J. (Stichting Reactor Centrum Nederland, The Hague). Atoomenergie Haar Toepass.; 16: No. 7-8, 166-174(Jul 1974). (In Dutch).

These are defined as wastes with activity greater than 0.2 R/h with insignificant content of α sources. There is sufficient space in Holland for storage of the expected waste of these types for the next 50 years, on reasonable assumptions of development of nuclear energy. (NL)

1296 RADIOACTIVE WASTE FROM THE FISSION CYCLE: QUANTITIES AND TRANSPORT. Verkerk, B. (Stichting Reactor Centrum Nederland, The Hague). Atoomenergie Haar Toepass.; 16: No. 7-8, 156-160(Jul 1974). (In Dutch).

These wastes are produced at all stages, from mine to reactor, and include material of long radioactive life (high level waste). The use of the plutonium cycle in particular produces toxic materials. One ton of uranium leads to products of total activity 98.5 curie after 1000 days. Incorporation of waste material in glass blocks and burying (in Western Europe) or controlled storage above ground (in England) is the usual means of disposal. Special conditions are laid down for the means of transport and containers used. (NL)

1297 LIMITATIONS OF THE CONCEPT OF RELATIVE RADIOACTIVE RISK. Smit, W. A.; de Vries, H. J. M. (Rijksuniversiteit Groningen (Netherlands)). Atoomenergie Haar Toepass.; 16: No. 7-8, 181-182(Jul 1974). (In Dutch).

This concept is applied to the risk involved on storage in salt mines in Holland of the waste from light water reactors. No general conclusion can be reached as to the acceptability of the atmospheric pollution produced; allowance must be made for the fact that the waste and/or its radiation will be absorbed into the hydrological cycle within about 300 yr. (NL)

1298 STORAGE OF FISSION WASTE IN ROCK SALT FORMATIONS. Hamstra, J. (Stichting Reactor Centrum Nederland, The Hague). Atoomenergie Haar Toepass.; 16: No. 7-8, 182-183 (Jul 1974). (In Dutch).

Other authors (Smit and De Vries, Atoomenergie, Dec 1973) have expressed the view that one single parameter is insufficient as a measure of the risk, owing to the different conditions encountered. The authors consider this coefficient to be satisfactory and apply it to fast fission reactors, which are shown to produce waste which is more dangerous than light water reactors. Estimates are given up to the year 1990 of the waste problem to be expected. (NL)

1299 UNDERGROUND WASTE MANAGEMENT AND ENVIRONMENTAL IMPLICATIONS. Proceedings of the Symposium held in Houston, Texas, December 6-9, 1971. Cook, T. D. (ed.). Memoir 18. Tulsa, OK; American Association of Petroleum Geologists (1972). 419p. (CONF-711233-).

From symposium on the underground waste management and environmental implications; Houston, Texas, USA (6 Dec 1971).

Fifty-one papers were presented at the symposium. A separate abstract was prepared for each of 4 papers. The remaining 47 papers were not within the scope of NSA. (LCL)

For abstracts of individual papers see: 1300 and 1301-1303.

1300 SUBSURFACE WASTE STORAGE: THE EARTH SCIENTIST'S DILEMMA. Stallman, R. W. (Geological Survey, Denver). pp 6-10 of Underground Waste Management and Environmental Implications. Cook, T. D. (ed.). Tulsa, OK; American Association of Petroleum Geologists (1972).

From symposium on the underground waste management and environmental implications; Houston, Texas, USA (6 Dec 1971). See CONF-711233-.

Liquid wastes in unprecedented quantities are expected to be injected below the land surface because of recent stringent controls on disposal to streams. Some of the possible consequences of waste injection are: groundwater pollution, surface-water pollution; changes in rock permeability; subsidence, earthquakes; and mineral-resource pollution. Although much work has been done to predict some of the effects, the current state of knowledge is not adequate to estimate them accurately. Theory regarding dispersion, nonlinear relations between rock stress and strain, and interrelations of hydraulics, heat, chemistry, and rock mechanics at macroscale is especially deficient for application to the waste problem. Advances in the chemical thermodynamics and kinetics of geochemistry may provide improved technology. (auth)

1301 DISPOSAL OF NUCLEAR WASTE BY IN-SITU INCORPORATION IN DEEP MOLTEN SILICATE ROCK. Lewis, A. E.; Cohen, J. J.; Braun, R. L. (Univ. of California, Livermore). pp 280-286 of Underground Waste Management and Environmental Implications. Cook, T. D. (ed.). Tulsa, OK; American Association of Petroleum Geologists (1972).

From symposium on the underground waste management and environmental implications; Houston, Texas, USA (6 Dec 1971). See CONF-711233-.

A method for disposing of nuclear-reactor wastes by in-situ incorporation in molten silicate rock involves injecting liquid wastes into a deep underground chimney and allowing them to self-boil. The resulting steam is processed at the ground surface and recycled into a closed system. When waste addition is terminated, the chimney is allowed to boil dry, thereby solidifying the waste. The heat generated by the radioactive waste then melts the surrounding rock, which dissolves the waste. Finally, the rock resolidifies, trapping the radioactivity in an insoluble rock matrix deep underground. This method has significant environmental and economic advantages over previously proposed methods. (auth)

1302 SORPTION PHENOMENA SIGNIFICANT IN RADIOACTIVE-WASTE DISPOSAL. Tamura, T. (Oak Ridge National Lab., TN). pp 318-330 of Underground Waste Management and Environmental Implications. Cook, T. D. (ed.). Tulsa, OK; American Association of Petroleum Geologists (1972).

From symposium on the underground waste management and environmental implications; Houston, Texas, USA (6 Dec 1971). See CONF-711233-.

Disposal of radioactive liquid wastes poses a particularly vexing problem, because these wastes contain various radionuclides and chemicals used in processing operations which are potentially dangerous, even in low radionuclide concentrations. Sorptive properties of minerals, particularly ion-exchange reactions, have been studied for potential direct application in waste treatment and for the purpose of defining the fate of radionuclides when released to soils and geologic formations. Because most waste streams normally contain stable-ion concentrations far in excess of radioactive ions, sorption reactions of interest are those which exhibit high selectivity for the radionuclides. Structural and/or steric factors are generally of highest significance in selective reactions. Micaceous minerals selectively sorb radiocesium from high-sodium, aluminum, or calcium solutions, primarily because of favorable structure. Zeolitic minerals show selectivity for certain ions by excluding other ions whose sizes exceed lattice parameters. Some sorbents show selective sorption reactions under particular pH conditions; thus, alumina and related hydrous oxides selectively sorb radioactive cobalt and radiostrontium in alkaline sodium systems. In addition to the exchange reactions, sorbent properties, such as flocculation, swelling, and absorption of liquids, and chemical properties of radionuclides are important considerations in waste-disposal operations and management. In practical applications of the sorptive phenomena in waste disposal, it is necessary to know the solution characteristics, sorbent properties, and formation characteristics, as well as the interactions of these factors. In the hydraulic-fracturing technique employed at Oak Ridge, the waste-solution characteristics influence the choice of sorbents used to prepare waste-cement slurries. The high-sodium salt concentration requires attapulgite instead of bentonite, and illite is added to fix radioactive cesium. To immobilize the mix after injection underground, cement is added, but the cement further complicates the reactions and behavior of the clay slurries. The behavior during injection and ultimate setting of the grout is further influenced by the characteristics of the formation. Each underground-disposal operation will require understanding of the environment into which the waste is to be placed. The final

facility and technique should be tailored to meet the requirements of maintaining safe operation and insuring long-term safety for future generations. (auth)

1303 DEEP DISPOSAL SYSTEMS FOR RADIOACTIVE WASTES. Belter, W. G. (Atomic Energy Commission, Washington, DC). pp 341-354 of Underground Waste Management and Environmental Implications. Cook, T. D. (ed.). Tulsa, OK; American Association of Petroleum Geologists (1972).

From symposium on the underground waste management and environmental implications; Houston, Texas, USA (6 Dec 1971). See CONF-711233-.

As of July 1, 1971, approximately 100 million kw of nuclear-power-plant capacity was in operation or under construction and/or contract. During the 1960s, an extensive research, development, and demonstration program was carried out on the treatment and disposal of all types of gaseous, liquid, and solid radioactive wastes. Geochemical research and extensive field exploration and demonstration studies have been carried out on several deep disposal systems for radioactive wastes, including the application of hydrofracturing techniques in bedded shale for low-heat-producing wastes and the use of bedded salt and crystalline bedrock for highly radioactive wastes. The Atomic Energy Commission has adopted a regulatory policy which requires that all high-level liquid wastes from licensed irradiated-fuel-reprocessing plants must be solidified and shipped to a national repository on land owned and controlled by the federal government. A tentative selection of a site near Lyons, Kansas, has been made for an initial salt-mine repository for the demonstration of long-term storage for both solid high-level and long-lived alpha-contaminated wastes. Because of a general requirement for adequate monitoring to assure the safe and effective operation of a deep-well injection system, this method has not been used generally for disposal of radioactive wastes. It appears that injection into deep permeable formations may be a practical solution for the disposal of large quantitives of tritium-bearing wastes from water reactors and nuclear-fuel-reprocessing plants in the future. Additional research is also required on the potential deep disposal of noble gases as ^{85}Kr from reactor and reprocessing-plant off-gas streams. (auth)

1304 HIGH-LEVEL RADIOACTIVE WASTE DISPOSAL. Lilkala, R. C.; McKee, R. W.; Winegardner, W. K. (Battelle-Northwest, Richland, WA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 19, 202-241(1974).

From topical conference on energy; Chicago, Illinois, USA (4 Feb 1974). See CONF-740201-.

The U. S. Atomic Energy Commission is developing additional plans and new methods for managing radioactive wastes generated by past, present and future operations. The objectives of these programs are to (1) ensure the health and safety of the public, (2) protect our environment and ecology, and (3) use methods acceptable to the public. A brief overview is presented of the plans and current studies for disposing of high-level radioactive waste generated in commercial nuclear facilities. The methodology being developed and used to assess the merits of alternate concepts is presented. The technical areas where the physics community might contribute to improving this program are outlined. (auth)

Handling Equipment and Procedures

Refer also to abstract 1307.

1305 (ALKEM-PuT-5) FLOW TESTS, FIRE AND EXPLOSION STUDIES IN PLUTONIUM WORKING SPACES AND GLOVE BOXES. Meer, W. ter; Muenster, M.; Aha, G.; Klinger, H. (Alpha Chemie und Metallurgie G.m.b.H. (ALKEM), Leopoldshafen (F. R. Germany)). [nd]. 125p. (In German). INIS.

With figs. and tabs. Available from ALKEM.

Flow tests, fire and explosion experiments in a steel containment serving as a model of the working place (a so called 'caisson'), fire tests with various materials as floor covering, and fire and explosion studies in a standard glove box under different conditions of ventilation are discussed in this comprehensive report. (GE)

Transportation

Refer also to abstract 836.

1306 (AERE-M-2636) ACTIVITY LIMITS FOR TYPE 'A' AND TYPE 'B' PACKAGES EXEMPTION LIMITS AND PACKAGE CATEGORIES. Davies, A. J. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Jul 1974. 12p. Dep. NTIS (US Sales Only) $4.00. UK 50 pence.

The I.A.E.A. Regulations for the Safe Transport of Radioactive Materials Safety Series No. 6 1973 Revised Edition give "exemption limits" in Section III which are generally based on the activity limits for type 'A' packages given in Table VII of Section IV. This table is a long list of different radionuclides and the purpose of this paper is to enable the user to determine exemption limits without having to calculate them from the Regulations. (auth)

1307 (CONF-741018-, pp 375-382) IRRADIATED FUEL AND CONTROL RODS TRANSPORT FROM A DECOMMISSIONED POWER REACTOR. Pryor, W. A. (Atomic Energy Commission, Oak Ridge, TN). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population exposures.

The decommissioning of the Boiling Nuclear Superheater (BONUS) Reactor in Rincon, Puerto Rico, involved the transport to the continental United States of irradiated fuel elements as well as the shim and control rods for reprocessing and disposal, respectively. The responsibility was assigned by the USAEC to the Oak Ridge Operations Office. Tasks included cask selection, cask and special equipment preparation, transportation arrangements, documentation, and shipment execution. Safety considerations were factored into each phase and Safety Analysis Reports were prepared for the cask and for the fuel and control rod baskets. Trial runs with the cask and special equipment were conducted prior to shipment to Puerto Rico. The applicable regulations of the USAEC and the Department of Transportation were followed. The completed task represented the cooperative efforts of two USAEC Operations Offices and two USAEC prime contractor organizations. (auth)

1308 (MLM-2074) SAFETY ANALYSIS REPORT FOR PACKAGING (SARP): MULTIHUNDRED WATT ISOTOPE HEAT SOURCE SHIPPING CONTAINER (MHW-IHS-SC). Griffin, J. F.; Johnson, E. W.; Rodriguez, L. F.; O'Brien, D. L. (Mound Lab., Miamisburg, Ohio (USA)). 28 Jun 1974. Contract AT-33-1-Gen-53. 277p. Dep. NTIS $7.60.

The technical information and limits pertinent to the construction and use of the Multi-Hundred Watt (MHW) Isotope Heat Source shipping container are presented. Discussions of structural integrity, thermal resistance, radiation shielding and radiological safety, nuclear criticality safety, and quality control are included. A complete physical and technical description of the package is presented. The packaging consists of a finned cask completely enclosed within a cage-type carrier and the contents consist of a high integrity MHW heat source producing nominally 2400 W from the decay of 4.2 kg of ^{238}Pu isotope in the form of a solid oxide. The results of the nuclear criticality safety analysis show that 6.3 kg of Pu may be shipped as Fissile Class I, whereas the MHW heat source contains only 5.3 kg of total plutonium. Design and development considerations, the tests and evaluations required to prove the capability of the containers to withstand normal transportation conditions, and the sequence of four hypothetical accident conditions (free drop, puncture, thermal and water immersion), are discussed. Tables, graphs, dimensional sketches, photographs, technical references, loading and shipping procedures, Mound Laboratory's experience in using the container, and a copy of the AEC/OSD/ALO interim certificate of compliance are included. (auth)

PARTICLE ACCELERATORS

Design, Development, and Operation

1309 (ANL-8096, pp 80-83) ACCELERATOR IMPROVEMENT. Apr 1974.
In Chemistry Division annual report, July 1972–June 1973.
The development of a superconducting helix linac at ANL for heavy ion acceleration is discussed. (WHK)

1310 (COO-1805-1) ACQUISITION OF THE ANL 4-MeV ELECTROSTATIC ACCELERATOR. Annual Report. Dixon, D. R. (Brigham Young Univ., Provo, Utah (USA). Dept. of Physics and Astronomy). 30 Sep 1974. Contract AT(11-1)-1805. 5p. Dep. NTIS $4.00.
The experimental facilities and programs are briefly described; and the financial and manpower status is given. (WHK)

1311 (DEU-73-21) PROGRESS REPORT 1970 OF THE ACCELERATOR LABORATORY OF THE UNIVERSITY AND TECHNICAL UNIVERSITY OF MUNICH. Santo, R.; Eberhard, K.; Hartmann, J.; Konecny, E. (comps.). (Muenchen Univ. (F. R. Germany); Technische Univ. Muenchen (F. R. Germany)). 1970. 67p. (In German).
The accelerator laboratory of the Munich University and Technical University, is equally available to both colleges for nuclear physics fundamental research and for education. The first report covering the period from 1966 to 1970 shows the building stage of the Tandem laboratory. In the autumn of 1970 the assembly and acceptance of the Emperor-Tandem accelerator was completed. (GE)

1312 (GSI-72-8) UNILAC PROJECT REPORT NO. 5. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)). Aug 1972. 28p. (In German).
This status report describes the main activities of the UNILAC project, e.g., beam optics, transport and injection, hf and other electronic equipment for structures of the accelerating part, buildings, test injector, computer configuration, and equipment for systems and process control (including binary data transmission in light pipes). (GE)

1313 (GSI-73-4) UNILAC PROJECT REPORT NO. 8. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)). Jun 1973. 47p. (In German).
The following topics are discussed: mechanism for the production of multiply charged ions in plasmatron sources, the stripper section of the UNILAC, the 1 MVA prototype anode power supply, a digital control system for magnet power supplies, electrolytic copper deposits for high-Q rf cavities, GSI laboratory, and accelerator buildings. (GE)

1314 (KHFTI-73-13, pp 3-6) RECONSTRUCTION PROJECT OF THE MULTICHARGED ION LINEAR ACCELERATOR. Bomko, V. A.; Revutskii, E. I.; Skoromnyi, G. M. 1973. (In Russian).
The modifications planned for the multicharged ion linear accelerator LUMZI-10 in order to increase the mass range of the accelerated ion, improve the beam intensity, guarantee conditions for the effective implementation of the even regulation of the energy of the accelerated particles, and to improve the beam characteristics in air are described. The principal parameters of the first and second sections of the accelerator are given. (INIS)

1315 (KHFTI-73-13, pp 7-10) PHYSICAL BASIS OF THE LUMZI-10 LINEAR ACCELERATOR INJECTOR RECONSTRUCTION. Meleshkov, S. I.; Skoromnyi, G. M.; Revutskii, E. I.; Kravshenko, S. F.; Chekanov, S. Ya.; Meleshkova, Yu. V. 1973. (In Russian).
The construction characteristics of the injector of the multicharged ion accelerator of the Kharkov Physico-Technical Institute are examined. It has the capacity of injecting ions with mass-to-charge ratios up to $m/k = 7$ and of providing for a reduction of the off-duty factor of the accelerating current because of the increase of the number of accelerator pulses up to 5 Hz. Some variations of the ion-optical system of the injector were examined. (INIS)

1316 (KHFTI-73-13, pp 60-65) MEASUREMENT OF THE EQUILIBRIUM CHARGE DISTRIBUTION IN He^+ AND Be^+ ION BEAMS. Skoromnyi, G. M.; Revutskii, E. I. 1973. (In Russian).
The experimental method and results were reported for the determination of the average beam charge and the equilibrium charge distribution in the ion beam passing through a carbon target with a density of 8×10^{17} at/cm^2. He^+ ion beams with energies of 0.5 MeV and 2 MeV and Be^{2+} ion beams with energy of 0.5 MeV were studied. The measurements were made using a Thomson mass spectrometer. The results obtained are compared with calculated data. (INIS)

1317 (LA-5708-PR) MEDIUM-ENERGY PHYSICS PROGRAM. Quarterly Report for the Period Ending April 30, 1974. Dunn, E. (comp.). (Los Alamos Scientific Lab., N. Mex. (USA)). Aug 1974. Contract W-7405-eng-36. 77p. Dep. NTIS $5.45.
During this report period, the accelerator was in operation from February 1 through March 15 for a total of 179 shifts. A seven-week period of continuous operation was included, as was the start of a ten-week period of continuous operation. As FY-74 draws to a close, it is fitting to report that the past fiscal year has been the most productive ever. This is documented in the attached Appendices A and B which reproduce talks presented on November 12, 1973, at the annual meeting of the LAMPF Users Group, Inc., and on March 1, 1974, to the staff involved with the development and operation of LAMPF. (auth)

1318 FERMI NATIONAL ACCELERATOR LABORATORY. CERN Cour.; 9: No. 14, 283-292(Sep 1974).
A review of the activities at the FermiLab is given. Topics include the performance of the accelerator, layout of experimental areas, experimental program, 15 foot bubble chamber, the energy doubler/energy saver/beam stretcher, the energy transfer system, superconducting energy storage, POPAE storage ring (Protons on Protons and Electrons), and the medical facility. (WHK)

Auxiliaries and Components

1319 (KHFTI-73-13, pp 51-54) RESONANCE RECHARGING DEVICE FOR THE MULTICHARGED ION LINEAR ACCELERATOR. Skoromnyi, G. M.; Revutskii, E. I.; Kas'yanov, Yu. V. 1973. (In Russian).
The technology for the fabrication of thin carbon targets by vacuum evaporation of carbon or graphite rods with subsequent deposition of the carbon on a glass base in the form of durable carbon films is described. The targets were designed for the resonance recharging used in the multicharged ion linear accelerator LUMZI-10 in order to increase the acceleration time and to expand the mass range of the accelerated ions. The construction characteristics and some results of the use of the device for resonance recharging are reported. (INIS)

1320 (KHFTI-73-13, pp 55-59) INVESTIGATION OF THE CHARACTERISTICS OF THE He ION BEAM PASSING THROUGH THE THIN CARBON TARGET. Skoromnyi, G. M.; Revutskii, E. I. 1973. (In Russian).
The experimental method and results of the determination of the characteristics (change of the beam divergence angle, distribution of the charged ions in the beam, and current density of the ions) of the He ion beam accelerated in the multicharged ion linear accelerator LUMZI-10 are described. Carbon films with a density of 0.5 to 1×10^{18} at/cm^2 were used as targets. (INIS)

1321 (KHFTI-73-13, pp 66-68) HIGH VOLTAGE SUPPLY FOR THE HEAVY-CURRENT INJECTOR. Venevtsev, I. T.; Skoromnyi, G. M.; Ptukhina, Z. E.; Revutskii, E. I.; Verbovskii, V. V. 1973. (In Russian).
The circuits and test results for a cascade generator for supplying a high-current injector are described. The generator can guarantee a pulsed load current up to 0.5 amp and voltages up to 800 kV and higher for durations up to several msec. The generator is characterized by low instability. (INIS)

1322 (KHFTI-73-13, pp 69-71) PULSE CASCADE TRANSFORMER. Venevtsev, I. T.; Skoromnyi, G. M.; Revutskii, E. I. 1973. (In Russian).
The construction characteristics of the high-voltage pulse cascade transformer designed for supply of the proton accelerator injector are described. The transformer has a voltage of 600 kV with pulse duration at the peak of 500 μ sec and pulse power of 500 kW. The transformer consists of five individual series coupled uniform transformers (cascades). (INIS)

1323 (KHFTI-73-13, pp 72-75) CASCADE GENERATOR WITH THE SILICON DIODE. Venevtsev, I. T.; Skoromnyi, G. M. 1973. (In Russian).
Studies connected with the development of a high-voltage cascade generator with a silicon diode without shunting capacitance in the rectifiers consisting of a set of series coupled diodes are described. The studies showed the great advantage of using silicon diodes for the construction of cascade generators because at sufficiently high values of the capacitance, high currents can be ob-

tained with the cascade generator during low voltage input and low pulsation. (INIS)

1324 (UCID-16598) DETERMINATION OF RADIAL BEAM PROFILE BY MEASURING X-RAY INTENSITY VS POSITION OF A WIRE TARGET. Leary, J. M.; Lauer, E. J.; Shuler, V. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Sep 1974. Contract W-7405-eng-48. 19p. Dep. NTIS $4.00.

The physics and mathematics of determining the radial current density of an electron beam from its experimental x-ray intensity data are described. It is necessary to invert an Abel's integral equation in the appropriate variables. This method will also allow one to deduce the plasma electron density from interferometer phase shift data. (auth)

1325 FOCUSING OF SUPERCONDUCTING SOLENOIDS IN HIGH-ENERGY LINEAR PROTON ACCELERATORS. Bondarev, B. I.; Kushin, V. V.; Murin, B. P.; Solov'ev, L. Yu.; Fedotov, A. P. Sov. At. Energy (Engl. Transl.); 34: No. 2, 172-174(Feb 1973).

Translated from At. Energ. (USSR); 34: No. 2, 131-133(Feb 1973).

The principal energy increment in linear proton accelerators energizing particles to 600 to 1000 MeV (meson factories) is brought about by resonator cavities operating at frequencies of 800 to 1000 MHz. Protons are focused by magnetic quadrupole doublets positioned between the resonator cavities and the sections comprising the resonators. This type of quadrupole focusing does not facilitate the effective inscribing of the beam in the accelerator aperture, because of the axial asymmetry resulting. The aperture diameter must be selected in the range of centimeters, so that the effective use of the radio-frequency power establishing the accelerating field in the resonator cavities is curtailed. To date, the development of superconducting solenoids has attained a level such that they can be employed in accelerators now under construction. The reliance on axially symmetric focusing by a longitudinal magnetic field established by superconducting solenoids has made it possible to narrow the aperture of the focusing channel and to reduce drastically the radio-frequency power required. Moreover, tolerances in the installation and stability of the components in the focusing channel can be relaxed appreciably. Particle dynamics in superconducting solenoids is discussed. (WHK)

1326 STUDY OF SHIELDING FOR BETATRON. III. Spectra of Scattered X-Rays From Various Shielding Materials for 4 to 30 MV X-Rays. Maruyama, T.; Sakata, S.; Kumamoto, Y.; Fukuhisa, K.; Hashizume, T. (National Inst. of Radiological Sciences, Chiba, Japan). Shimadzu Hyoron; 31: No. 1-2, 39-44 (Jun 1974). (In Japanese).

The photon spectra of secondary radiations from shielding materials (lead, iron, heavy and ordinary concrete, and water) have been studied experimentally over the megavoltage region 4 to 30 MV, using a NaI(Tl) scintillation spectrometer, from the point of view of radiation protection of a medical betatron. The measured pulse-height distributions were converted to photon spectra, using inverse response matrices of the crystal. The resultant spectra show that scattered radiations consist of three components, i.e., Compton photon, annihilation radiations with an energy of 0.511 MeV and bremsstrahlung photons in the scatterer due to electrons, and to positrons from photon interactions. The results of the scattered radiation spectra determined at the angles of 45°, 90°, and 135° are tabulated in the unit of the relative photon number per unit energy interval. The average energy of scattered radiations was calculated from the spectra. (auth)

1327 MAGNETE: Grundlagen, Aufbau, Anwendungen. (Magnets: Basic Relations, Engineering, Applications). Schnell, G. Thiemig-Taschenbuecher, Band 49. Munich; Verlag Karl Thiemig (1973). 241p. DM 43,-.

The principles for the calculation of magnetic fields are given with numerous examples. Eddy currents, shielding problems, and the use of superconductors are also treated. The materials used in the production of magnetic fields, electric conductors including superconductors, insulators, and the magnetic material itself, the technology of coils, and the measurement of magnetic fields are discussed. The primary emphasis is in the sections on magnets with and without iron. A multitude of examples and actual applications are given. These include ironless magnets for the production of homogeneous and inhomogeneous fields in solenoids of various forms, superconducting magnets, stellerators, and magnetic mirrors with their use in electron microscopy and plasma physics. Magnets with iron are used for the production of homogeneous fields, acceleration and deflection magnets for accelerators, and magnets with inhomogeneous fields as quadrupole magnets for particle optics. The permanent magnets used in many areas are discussed. (JSR)

Ion Sources and Injection and Extraction Systems

1328 (CONF-741019-3) HIGH INTENSITY H^- SOURCE FOR INJECTION INTO PROTON SYNCHROTRONS. Fasolo, J. A.; Moenich, J. S.; Abraham, J.; Gorka, A. J. (Argonne National Lab., Ill. (USA)). 1974. 13p. Dep. NTIS $4.00.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

The operational reliability required of an H^- ion source for direct or booster injection into a proton synchrotron was demonstrated during the January-February 1974 test of the Zero Gradient Synchrotron (ZGS) booster. During this test, the beam was pulsed at 4 to 10 Hz rates for a total of $\sim 1.7 \times 10^7$ pulses, equivalent to 46 days of operation at the normal booster-ZGS duty cycle of 15 pulses at a 30 Hz rate once every 3.5 sec. The average 50 MeV current to the booster for pulses of 200 μsec duration was ~2.0 mA. Recently, the 50 MeV current has been increased to about 3.3 mA, average, during preliminary operation with a modified source in which ions are extracted from an expanded plasma front in a cusped magnetic field. Factors which have contributed to the improved reliability of the source are: (1) a cleaner cathode environment; (2) replacement of a short-lived ($\leq 10^6$ pulses), 1-Hz gas shutter by a wear-free, 30-Hz chopper valve that reduces average gas flow to a third of the instantaneous value; (3) replacement of the fine-mesh, woven-screen tungsten extractor grid by a 20 mil thick, 77% transparent grid in which parallel W-3Re ribbons are mounted in a grooved stainless steel ring which clamps one end of each ribbon. This grid survived bombardment by 15 to 16 keV positive ions at a current density greater than 1 A/cm^2 to a total dose greater than 3400 coulombs/cm^2; there was no evidence of the embrittlement that caused premature failure of the woven tungsten grids. The terminal vacuum system, which uses two titanium bulk sublimators and a 1200 l/sec ion pump, can run continuously for about 3 weeks before the sublimators and the lower part of the vacuum chamber are replaced as a unit during a routine maintenance period. (auth)

1329 (KFK-2026) STUDIES OF A HIGH CURRENT ELECTRON BEAM SOURCE FOR THE ELECTRON-RING-ACCELERATOR. Dustmann, C. H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Experimentelle Kernphysik). Jul 1974. 53p. (In German). Dep. NTIS (U. S. Sales Only) $5.75.

Thesis. Submitted to Karlsruhe Univ. (West Germany). Fakultaet fuer Physik.

A field emission diode was developed for the Febetron 705 that delivers from a 2.3 MeV 3 to 4 kA electron beam, 650 A into the emittance of 0.05 π cmrad. Further investigations proved the formation of a dense plasma cloud surrounding the emission, so that the current is determined by the Child-Langmuir's law of space-charge limited current. The expansion-velocity of this plasma cloud could be determined by measuring the time delay between the voltage and current maximum to be 10 to 20 cm/μsec in dependance of the cathode-anode spacing. (auth)

1330 (LBL-3024) HEAVY ION SOURCE DEVELOPMENT AT BERKELEY. Chintalpudi, S.; Clark, D. J.; Gavin, B.; Grunder, H.; Holley, W. R.; Richter, R. M.; Selph, F.; Zajec, E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1974. Contract W-7405-eng-48. 19p. (CONF-740559-1). Dep. NTIS $4.00.

From conference on plasma science; Knoxville, Tennessee, USA (15 May 1974).

The continued improvement of heavy ion sources is of particular importance at Lawrence Berkeley Laboratory, as at present four heavy ion injectors are used in LBL accelerator operations. Two of these serve the SuperHILAC (a heavy ion Alvarez linac), another serves the Bevatron injector (a 20 MeV Alvarez linac operating in the 2βλ mode), the fourth is used at the 88-inch cyclotron. All of these injectors use PIG sources at present, with modifications in each case to suit the special requirements of the accelerator. At the SuperHILAC the need is for large duty factor (15 to 50%), long lifetime sources. The present source supplies 3.0μA, av. of Kr^{4+} at 16% duty factor, measured after acceleration to 9.5 MeV. At the 2βλ Bevatron injector requirements are for very high charge state of the lighter ions (up to neon), with low duty factor operation. At present 1μA, peak of Ne^{5+} is achieved at 2.4 MeV. At the 88-inch cyclotron interest centers on usable beams of the highest possible charge state, because particle energy in the extracted beam varies as the square of the charge state. Currently 0.2μA, av. of 214 MeV Ar^{3+} is available. (auth)

1331 (UCRL-75789) ICT HIGH EFFICIENCY DUOPLASMATRON ION SOURCE. Booth, R. (California Univ., Livermore

(USA). Lawrence Livermore Lab.). 9 Sep 1974. 5p. (CONF-741019-2). Dep. NTIS $4.00.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

The duoplasmatron ion source of the Livermore 400 kV ICT accelerator has been modified to increase the target current from the accelerator. In routine operation D^+ currents on target of 18 to 22 mA are now produced rather than the 5 to 8 mA originally available. The major modification to the source has been the installation of a focus electrode between the plasma expansion cup and the accel-decel extraction electrode system. With this arrangement the source output may be varied from maximum down to zero beam level without excessive extractor loading. Beam divergence varies from 6 mrad to 30 mrad. The focusing and extraction electrodes are simple to fabricate and are radiation cooled. Beam transport efficiency of 75% has been obtained through the 15 m long × 10 cm diameter transport system. The increase in target current has been obtained without decreasing the reliability of the accelerator. (auth)

Ion Optics and Field Calculations

1332 (KHFTI-73-13, pp 11-12) INVESTIGATION OF THE WAVE TYPE DEGENERATION IN THE RESONATOR WITH DRIFT TUBES UNDER THE RESONANCE PIN EFFECT. Bomko, V. A.; Klyucharev, A. P.; Rudyak, B. I. 1973. (In Russian).

The results of the experimental study of wave-type degeneration under the influence of resonance pins used for forming waves are reported. Questions related to the methods of stabilization of the distribution of the accelerating fields were also examined. (INIS)

1333 (KHFTI-73-13, pp 13-21) STUDY OF THE COUPLING COEFFICIENT IN THE ACCELERATING STRUCTURE WITH RESONANCE STABILIZATION DEVICES. Bomko, V. A.; Rudyak, B. I. 1973. (In Russian).

The effects of the coupling coefficient for different conditions of excitation of artificial resonance were studied. The optimum characteristics of the device for the stabilization of the distribution of the accelerating fields of the working waves were selected. The frequency dependence of the resonance wave-type transformation of the lower edge of the spectra of the accelerating structures of the multicharged ion linear accelerator LUMZI-10 during injection in the accelerator of one element of the antipode-type stabilization system in the form of a conducting pin was shown. The results of the study of the dependence of the size of the coupling coefficient on the size of the diameter and placement of the pin are reported. (INIS)

1334 (KHFTI-73-13, pp 22-28) DISPERSION PROPERTIES AND THE FIELD STRUCTURE IN THE RESONATOR CHARGED WITH SEVERAL RESONANCE PERTURBATIONS. Popov, V. A.; Pirotti, E. L.; Khizhnyak, N. A. 1973. (In Russian).

The problem on the perturbation of the fields of resonators by a chain of objects was solved by means of integral differential equations equivalent to the Maxwell equations and automatically complying with the boundary conditions at the surface of the perturbing object. As an example the problem on the perturbation of cylindrical resonators with two dielectric spheres placed on the axis of the resonator is examined. The results of the numerical solution of the dispersion equations obtained are shown in graphic form. (INIS)

1335 (KHFTI-73-13, pp 29-34) INVESTIGATION OF THE DISPERSION CHARACTERISTICS OF CHARGED RESONATORS EXCITED BY H-TYPE WAVES. Kovpak, N. E.; Papkovich, V. G.; Khizhnyak, N. A.; Shulika, N. G. 1973. (In Russian).

The dispersion properties of charged resonators were studied. The method for the calculation of the resonance frequency of cylindrical resonators charged by drift tubes strengthened by special holders (combs) is described under the assumption that the capacity of the equivalent oscillation contour was concentrated on the axis between the drift tubes and its induction was formed by chains consisting of the cylindrical surface of the resonator and the density of the combs. The results of the experimental study of the effect of the dimensions of the resonator and charge elements on the resonance frequency of the resonator are reported. (INIS)

1336 (KHFTI-73-13, pp 35-39) INVESTIGATION OF THE ELECTRIC FIELD STRENGTH DISTRIBUTION ON THE AXIS OF THE CHARGED H-RESONATOR. Baranov, L. N.; Bryzgalov, G. A.; Kovpak, N. E.; Papkovich, V. G.; Khizhnyak, N. A.; Shulika, N. G. 1973. (In Russian).

The calculation and experimental study of the electrodynamic characteristics of cylindrical resonators charged with drift tubes, strengthened with drift combs, are described. The results of the experimental study of the distribution of the electric field along the gap between the drift tubes are reported. The distribution of the intensity of the electric field of the resonator as a function of the number of gaps and as a function of the angle of the suspension bracket is shown in graphic form. It was shown that for relatively short resonators with a corresponding selection of the configuration of the combs the decrease of the intensity of the electric field along the resonator axis can be significantly reduced. (INIS)

1337 (KHFTI-73-13, pp 40-43) INVESTIGATION OF THE DISPERSION CHARACTERISTICS OF THE RESONATOR CHARGED WITH DRIFT TUBES WITH SUSPENSIONS BY A FEW PAIRS OF COMBS. Kovpak, N. E.; Papkovich, V. G.; Khizhnyak, N. A.; Shulika, N. G. 1973. (In Russian).

The calculation and experimental study of the dispersion characteristics of long resonators charged with drift tubes mounted on several pairs of combs so that the electrical field of the resonator is divided on the individual sections with similar eigenfrequencies of the oscillator contours being formed are described. The experimental results and the calculated results for three- and four-contour systems are reported. (tr-auth)

1338 (KHFTI-73-13, pp 44-47) DISPERSION DEPENDENCES OF THE WAVEGUIDES CHARGED BY DIELECTRIC DISKS WITH THE CENTER BOND HOLE. Papkovich, V. G.; Khizhnyak, N. A. 1973. (In Russian).

The analytical study of the propagation of electromagnetic waves in waveguides charged with dielectric discs with holes is described. The dispersion equations obtained were solved by the integration method on the M-220 computer. The results are reported. The dependence of the phase velocity of the waves on the size of the radius of the central hole is shown. (INIS)

1339 (KHFTI-73-13, pp 48-50) EXPERIMENTAL INVESTIGATION OF THE WAVEGUIDES CHARGED WITH DIELECTRIC DISKS. Bryzgalov, G. A.; Kaplin, S. S.; Papkovich, V. G.; Khizhnyak, N. A.; Shulika, N. G. 1973. (In Russian).

The dispersion characteristics of waveguides charged with dielectric discs were studied by the method of non-resonance perturbation. The method was based on the measurement of the total reflection coefficient from the perturbing body during movement of the body along the axis of the waveguide. The method made it possible to determine the phase velocity of the delayed wave and the distribution of the intensity of the electric field according to the period of the system. A block diagram of the set-up for carrying out the experiment is presented. The results of calculations and experimental determination of the phase velocity for charged waveguides are given in graphic form with a consideration of the central bond hole and for waveguides with solid discs. The distribution of the intensity of the electric field according to the length of the period of the system studied is shown. (INIS)

1340 (KHFTI-73-13, pp 78-81) COLLECTIVE ION ACCELERATION BY MODULATED HIGH-PERMEANCE ELECTRON FLOW. Lymar, A. G.; Khizhnyak, N. A.; Belikov, V. V. 1973. (In Russian).

A scheme is proposed for the collective acceleration of charged particles by means of fields excited by the potential sag in a limited electron flow being propagated in a conducting screen. The results of the calculation of the dependence of the electron beam current on the relative sag of the potential and the results of the evaluation of required intensity of the electric field are reported. (INIS)

1341 NONPARAXIAL FOCUSING OF BEAMS OF CHARGED PARTICLES IN THE MEDIAN PLANE OF AN AXISYMMETRIC MAGNETIC FIELD FOR AN ARBITRARY RANGE OF VARIATION OF PARTICLE MASSES. Malov, A. F.; Suzdalev, V. A.; Zaboev, A. I.; Fedoseev, E. P. (Inst. of Atomic Energy, Moscow). Sov. Phys. – Dokl. (Engl. Transl.); 18: No. 11, 725-726(May 1974).

Translated from Dokl. Akad. Nauk SSSR; 213: No. 3, 556-559 (Nov 1973).

At the present time only one system is known for the first-order focusing of a beam with a wide range of masses—the Danysz system of focusing in a uniform field. Narrow beams for which second-order aberrations can be neglected are focused along a straight line passing through the source point and normal to the central trajectory of the beam at this point. The mass scale has a quadratic dependence of radius on mass. In many respects this inflexible regularity is very inconvenient. The problem of first-order focusing in the median plane of an axisymmetric field with an arbitrarily chosen mass scale is solved by using as an example a wide-range scheme with a quasi-linear mass scale. (WHK)

1342 LONGITUDINAL INSTABILITY OF INTENSE BEAM OF CHARGED PARTICLES IN A CYCLIC ACCELERATOR. Naugol'nyi, N. N. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 7, 1075-1079(Jul 1974). (In Russian).

The longitudinal instability of the intense charged particles beam coasting in the non-ideal metal chamber was investigated. With beam density increasing the oscillation natural frequency shift is shown to result in the negative mass instability stabilization. The beam instability increments to short-wave perturbation are obtained. (auth)

Storage Rings

1343 SELF-FOCUSING OF A RELATIVISITC ELECTRON RING WITH COHERENT RADIATION. Krasovitskii, V. B. Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 12, 1632-1637(Jun 1974).

Translated from Zh. Tekh. Fiz.: 43: No. 12, 2599-2608(Dec 1973).

Collective instabilities of a relativistic annular electron beam (a cylindrical sheath) caused by the synchrotron radiation of the electrons in a magnetic field are analyzed. The dispersion relation can be used to find the excitation conditions and to determine the growth rate of the instability for two modes excited in the beam, i.e., surface waves and volume space-charge waves. The effect of the radiation field on the beam leads to the establishment of an equilibrium transverse dimension so that the beam is focused or defocused by the radiation, depending on the initial width. The equilibrium ring width, the characteristic time for the establishment of a steady-state, and the external accelerating electric field required to balance the energy loss due to radiation are determined. (auth)

Experimental Facilities

Refer also to abstracts 721 and 724.

1344 (JINR-16-7104) 0.5 TO 100-MeV ELECTRON ACCELERATORS AS RADIATION SOURCES. Tsovbun, V. I. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1973. 23p. (In Russian). INIS.

Data on the output of bremsstrahlung and photoneutron radiation during bombardment of different targets with electrons at energies from 0.5 to 100 MeV are generalized. Data of a reference nature, necessary for the calculation of the shielding of electron accelerators and evaluation of the radiation field around them, are reported. (tr-auth)

1345 (SAND-74-0152) WAVEFORM DIGITIZING SYSTEM. Part I. Bourgeois, N. A. Jr. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1974. Contract AT(29-1)-789. 41p. Dep. NTIS $5.25.

A computer controlled six channel waveform digitizing system has been designed using largely commercially available hardware for real-time digitizing of the neutron output waveform of neutron generators. The software operating system was developed around a modified and extended version of Digital Equipment Corporation's BASIC interpreter. Instructions for the use of the modifications and extensions are presented. (auth)

1346 UNIVERSITY ISOTOPE SEPARATOR AT OAK RIDGE: THE UNISOR CONSORTIUM. Hamilton, J. H. (Vanderbilt Univ., Nashville). Science; 185: No. 4154, 819-824(6 Sep 1974).

The UNISOR consortium is a unique cooperative venture between a group of public and private universities, a national laboratory, a state government, and the Atomic Energy Commission (AEC), formed for the primary purpose of making and studying new, extremely unstable radioactive nuclei. To do this, the universities, the state of Tennessee, and the AEC have collectively purchased the University Isotope Separator at Oak Ridge (UNISOR), a magnetic isotope separator placed on-line to the Oak Ridge Isochronous Cyclotron (ORIC). The separator is owned by the universities and installed at the AEC national laboratory at Oak Ridge, Tennessee. The development of the facility and the research program are described. (WHK)

1347 DESIGN OF X-RAY TARGETS FOR HIGH ENERGY LINEAR ACCELERATORS IN RADIOTHERAPY. Podgorsak, E. B.; Rawlinson, J. A.; Glavinovic, M. I.; Johns, H. E. (Ontario Cancer Inst., Toronto). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 121: No. 4, 873-882(Aug 1974).

The 25 MeV electron beam was extracted from a Varian Clinac-35 linear accelerator and made to produce x-rays in thick targets of different materials. The x-ray beams were flattened by filters of various materials. It was found that an aluminum thick target gives a more penetrating beam in the forward direction than does a lead or tungsten target. It was concluded that contrary to conventional practice, low atomic number materials should be used for the targets and flattening filters of high-energy radiotherapy linear accelerators. (WHK)

1348 POSITRON SPECTRA GENERATED BY BREMSSTRAHLUNG WITH ENERGIES UP TO 800 MeV. Potemkin, G. V.; Vorob'ev, S. A. Sov. At. Energy (Engl. Transl.); 35: No. 5, 1059-1061(Nov 1973).

Translated from At. Energ. (USSR); 35: No. 5, 366-368(Nov 1973).

Studies of the conversion of bremsstrahlung into high energy positrons were conducted at the Sirius synchrotron of the Tomsk Polytechnical Institute. The energy dependence of the yield of positrons was measured for various thicknesses of copper and lead and the results are given. The optimization of the target thickness is discussed. (WHK)

1349 PHYSICO-TECHNICAL PROVISION OF IRRADIATION BY A NARROW BEAM OF PROTONS WITH ENERGY OF 200 MeV OF INTRACRANIAL TARGETS. Lomanov, M. F.; Kleinbok, Ya. L.; Pavlonskii, L. M.; Minakova, E. I.; Blokhin, S. I.; Khoroshkov, V. S.; Shimchuk, G. G. (Inst. of Theoretical and Experimental Physics, Moscow). Med. Radiol.; 19: No. 7, 56-62(Jul 1974). (In Russian).

Equipment for spot irradiation of intracranial targets in small animals by a beam of protons with energy of 200 MeV obtained on the ITEP synchrotron is described. The stereotaxic apparatus designed for this purpose ensures the accuracy of placing the target on the axis of the beam better than 0.3 mm. Narrow proton beams with a circular cross-section (diameter 3 and 5 mm) and with the triangular cross-section (the base of 2 mm long and 1 mm high) were obtained. Dose fields of the beams have a high marginal gradient. A highly sensitive noise-protective electromagnetic pick-up has been designed; it allows one to measure pulse current of the beam from 2×10^{-5}A and more with an accuracy of ± 5%. Methods of dose fields measuring are described, and radiation loading on the body of the animal and on the tissues which surround the irradiated part were assessed. (auth)

1350 MAGNETIC SPECTROMETER FOR PHOTON TAGGING SYSTEM. Bagdasaryan, L. S.; Barsegyan, E. O.; Tashchyan, A. A.; Khaldybanov, V. Kh. (Erevan Inst. of Physics). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 8: No. 5, 371-376 (1973). (In Russian).

A magnetic spectrometer having a constant dispersion on its focal line is described. It allows one to tag photons in a wide energy range with only a small number of detectors and associated fast electronics. (auth)

1351 TECHNIQUES USED IN THE PREPARATION OF THIN NUCLEAR TARGETS. Lazar, I. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 26: No. 1, 115-131(1974). (In Rumanian).

General methods of thin film preparation are discussed. Techniques to produce thin nuclear targets by vacuum evaporation and electron bombardment are described in detail. Some measurement methods of nuclear target thickness are presented. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

1352 (AD-778474) GEOPHYSICS AND SPACE DATA BULLETIN. Volume 10, number 4. Fourth quarter, 1973. Carrigan, A. L. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). Mar 1974. 275p. (AFCRL-TR-0107; AFCRL-SR-175). NTIS $6.50.

The bulletin is a quarterly publication that contains AFCRL contract and inhouse data reported from sites throughout the world. Program descriptions for all data sections are updated annually or as required, and are presented in number 1 of each volume. The following types of data are contained within each issue: magnetometer, cosmic ray elf noise, riometer, solar optical and radio emission, and ionosonde. This issue covers such data for October, November, and December 1973. (GRA)

1353 PROCEEDINGS OF THE SYMPOSIUM ON THE COLLECTION AND ANALYSES OF ASTROPHYSICAL DATA. Biraud, Y. (ed.). Astron. Astrophys., Suppl. Ser.; 15: No. 3, 321-534(Jun 1974).

Forty-two papers are presented on the following subjects: telescope and receiver control, data acquisition and pretreatment, and posttreatment of data. (MHR)

1354 ASTROPHYSICAL PLASMAS. Tayler, R. J. (Univ. of Sussex, Brighton, Eng.). pp 323-339 of Plasma Physics. Keen, B. E. (ed.). London; Inst. of Physics (1974).

The range of properties of astrophysical plasmas, including particle density, magnetic field strength, temperature, electrical conductivity, magnetic flux, the existence of strong electromagnetic waves, and the presence of instabilities, are considered. A number of problems in astrophysics in which plasmas and magnetic fields play an important part are briefly discussed. These include; magnetohydrodynamic stability of stars, the structure of the galactic disc, double extragalactic radio sources, pulsars, and the solar atmosphere. (UK)

Cosmic Radiation

Refer also to abstracts 578, 617, 1375, 2023, 2050, and 2308.

1355 (AD-775614) UNIFIED RANGE SPECTRUM AND LET DISTRIBUTION FOR HZE PARTICLES OF GALACTIC RADIATION IN SPACE. Schaefer, H. J. (Naval Aerospace Medical Research Lab., Pensacola, Fla. (USA)). 14 Dec 1973. Contract NASA ORDER-W-13-280. 26p. (NAMRL-1198). NTIS $3.25.

A unified range spectrum for the flux densities of HZE particles of galactic radiation in space is presented for establishing the individual spectrum for any z number with a simple scaling procedure. Data on z abundances are presented and the z spectrum from z = 2 to 28 is divided into four classes. Range spectra for the class representatives are derived. The influence of the geomagnetic cutoff on the range spectra for different latitudes is discussed. The data are summarized in two graphs from which event sizes in terms of let and related track lengths and their frequencies for given target volumes can be read directly. (auth)

1356 (AD-779678) EXTENDED SET OF COSMIC-RAY VARIATIONAL COEFFICIENTS. Gold, R. E.; Peacock, D. S.; Shea, M. A.; Smart, D. F. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 4 Feb 1974. Contract F19628-73-C-0070. 87p. (AFCRL-SR-173; AFCRL-TR-74-0063). NTIS $4.00.

Variational coefficients quantitatively relate cosmic-ray spatial anisotropies and spectral changes to variations in ground-based cosmic-ray monitor counting rates. The concept of the variational coefficients was introduced in 1963, and two sets of tables have been published, yet rarely used. One reason for their low usage is related to the specialization of the existing tables for studies of diurnal variations. The authors have calculated variational coefficients that are applicable to the analysis of a wide variety of transient cosmic-ray phenomena. They differ from the existing tables in that they are calculated for (1) a wide range of upper limiting rigidities from 29 to 500 GV; (2) power law rigidity spectra extending to exponents as high as +1.6; (3) spatial profiles independent of latitude; and (4) longitudinal profiles including square waves of 10 degrees, 30 degrees, 60 degrees, and an isotropic case. (auth)

1357 (ANARE-DR-122) COSMIC RAY RECORDS, MAWSON, 1971. Buckland, R. A.; Parer, D. (Australian National Antarctic Research Expeditions). 1973. 111p. Dep. NTIS (US Sales Only) $8.75.

Tables of data which are given include: 1) hourly data from the vertical telescope, 2) data from the wide-angle inclined telescope from geomagnetic east and west azimuth headings, 3) data from the high zenith angle telescope from geographic north and south azimuth headings, 4) uncorrected hourly data from the neutron monitor, 5) data from the neutron monitor, corrected for barometric pressure variations, 6) hourly mean station level pressure, 7) upper air data from all radiosonde flights conducted from the station. (AU)

1358 (RRK-73-11) EXOTIC PRIMARIES AND URBARYONS. Terasaki-Okada, K. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). May 1973. 11p. NTIS (US Sales Only).

Some difficulties are pointed out for various exotic primaries introduced to get rid of the difficulty of the cut-off at $\sim 10^{20}$ eV in the spectrum of primary cosmic rays. In place of these exotic primaries, urbaryons are considered as primary cosmic rays of ultra high energies. (auth)

1359 SECULAR VARIATIONS IN THE ABUNDANCES OF HEAVY NUCLEI IN COSMIC RAYS. Bhandari, N.; Padia, J. T. (Physical Research Lab., Ahmedabad, India). Science; 185: No. 4156, 1043-1045(20 Sep 1974).

The ratios of fluxes of heavy cosmic-ray nuclei [$(30 \leq Z \leq 40)/(20 < Z \leq 28)$, where Z is the atomic number], based on studies of meteorites and lunar samples, show little variation with time, distance in the solar system (1 to 3 astronomical units), or kinetic energy (30 to 2000 megaelectron volts per nucleon). Samples exposed for time intervals of 10^3 to 10^6 years show that the variations in the flux of $30 \leq Z \leq 40$ nuclei relative to that of the iron group nuclei ($20 < Z \leq 28$) have remained within the range of $(1.3 \pm 0.6) \times 10^{-3}$ during the last billions of years, thus indicating a remarkable similarity in the elemental composition of sources responsible for these nuclei in the cosmic radiation. (auth)

1360 A PROGRAM FOR THE ANALYTIC SIMULATION OF EXTENSIVE AIR SHOWERS. Goorevich, L. (Sydney Univ. (Australia). School of Physics). Comput. Phys. Commun.; 7: No. 6, 344-352(Jun 1974).

Air shower simulations allow one to compare the predictions of various models with experimental results of extensive air showers (EAS) arrays. Direct Monte Carlo methods are not practical, in terms of computing time, for the ultra-high primary energy ($\sim 10^{20}$ eV) and low thresholds (~1 GeV) now detectable. An analytic method is therefore used to predict the mean values of observables such as hadron energy spectra, muon shower size and electron shower size. The diffusion equations for nucleons and charged pions are solved by the method of "successive generations." This involves an iterative procedure in which the energy spectra of nucleons and charged pions, as a function of depth, are found by numerical integration. Other observables are derived from these basic spectra. (NL)

1361 THE INFLUENCE OF THE ENERGY DEPENDENCE OF THE DIFFUSION COEFFICIENT OF THE SPECTRUM OF THE ELECTRON COMPONENT OF COSMIC RAYS AND THE RADIO BACKGROUND RADIATION OF THE GALAXY. Bulanov, S. V.; Dogel, V. A. (AN SSSR, Moscow. Fizicheskij Inst.). Astrophys. Space Sci.; 29: No. 2, 305-318(Aug 1974).

The diffusion of electrons through interstellar space, and the energy dependence of the diffusion coefficient are considered. Apart from the case D = const the spectral index for electrons with spectral index γ_0 changes according to $\gamma_0 + \mu \rightarrow \gamma_0 + \frac{1}{2}\mu + \frac{1}{2} \rightarrow \gamma_0 + 1$. $(D(E) = D_0(E/E_0)^\mu)$ for $\mu < 1$; for $\mu > 1$ to $\gamma_0 + 1 \rightarrow \gamma_0 + \frac{1}{2} \rightarrow \gamma_0 + \mu$. The radio emission spectrum is considered in such a case. From a comparison with observations the limit $\mu < 0.4$ is obtained. (auth)

1362 THE INFLUENCE OF SOLAR MODULATION ON THE SEA-LEVEL COSMIC-RAY MUON SPECTRUM MEASURED AT KIEL. O'Brien, K. (USAEC New York Operations Office, N. Y. Health and Safety Lab.). Phys. Lett., B; 51: No. 2, 153-157(22 Jul 1974).

A theoretical investigation of the effect of solar modulation on the sea-level cosmic-ray muon spectrum measured at Kiel is carried out. An absolute calculation of the Kiel spectrum yields good agreement. The calculated value of the muon intensity at 1 GeV/c is 2.69×10^{-6} per (cm^2 sr sec MeV/c) within 2.5% of the Kiel value of 2.79×10^{-6}. (auth)

1363 THERMOLUMINESCENCE OF CHONDRITES. Kashkarova, V. G.; Stakheeva, S. A.; Stakheev, Yu. I.; Mel'nikova, L. N. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya; No. 6, 952-955(Jun 1974). (In Russian).

Data showed that the primary contribution to the total luminescence of meteorites is the plagioclase component. In general, a positive correlation was found between the thermoluminescent intensity and the degree of recrystallization of the meteorite. The low illumination of the exceptions to this was due to the presence of maskelynite, formed from the plagioclase by very high pressures. The intensity of the first maxima of the artificially induced (up to saturation) thermoluminescence showed the best correlation with the degree of recrystallization. (MG)

1364 ACOUSTIC OSCILLATIONS IN THE COSMIC MAGNETOACTIVE MEDIUM. Gidalevich, E. Ya. (Inst. of Geophysics, Sverdlovsk, USSR). Astrophysics (Engl. Transl.); 8: No. 4, 347-351(1972).

Translated from Astrofizika; 8: No. 4, 591-597(1972).

In the nonrelativistic approximation a study was made of the role of cosmic rays in the total pressure of interstellar gas. The magnetic field is an instrument that transmits momentum from the cosmic rays to the "ordinary" interstellar gas. The interstellar gas is described by the equations of magnetogasdynamics and the cosmic rays are described by the Chew–Goldberger–Low system. It is shown that in the presence of a magnetic field the cosmic rays make a significant contribution to the total velocity of sound. (auth)

1365 NATURE OF SOME COSMIC X-RAY SOURCES. Ryter, C. (CEN de Saclay, Gif-sur-Yvette, France). Bull. Union Physiciens; 68: No. 564, 789-796(Apr 1974). (In French).

Cosmic x-ray sources are divided into three groups: stellar x-ray sources; the remnants of supernovae; extragalactic sources. Stellar x-ray sources represent the majority of sources situated along the galactic equator, six of these sources being associated with stars, most of which are binary. X-ray spectra studies generally suggest an accretion model and a very compact system in which a neutron star and an ordinary star coexist. (FR)

1366 SUCCESSIVE ANALYSIS OF THE THREE DIMENSIONAL ANISOTROPY OF COSMIC RAY. Yasue, S. (Shinshu Univ., Matsumoto, Japan). Uchusen Kenkyu; 18: No. 1, 119-126 (Aug 1973). (In Japanese).

The analysis of worldwide data on cosmic ray neutrons was performed to obtain the information concerning the state of interplanetary space. Isotropic component and the flow of cosmic ray, that is, daily variation were considered as the components of spatial distribution of cosmic ray. Carotational component and the pitch angular distribution around a reference axis were taken into consideration. The formulation of analysis was given by K. Nagashima (Rep. Ionos. Space Res. Japan; 25: 190(1971)). The used data were the worldwide data of cosmic ray neutron meters taken for the periods from Aug. 26 to Sep. 2, 1966 at 38 stations, and from Sep. 21 to Sep. 27, 1966 at 35 stations. The results show that Forbush decrease was seen twice during 30 days, and the amplitude of daily variation anisotropy increased with the start of the decrease, and the advance of phase was seen. The value of X^2 was larger than the expected value, and became larger with the start of the Forbush decrease. Various reasons of the large X^2 can be considered. The value of X^2 was better than the case in which the pitch angular distribution was not taken into consideration. (JA)

1367 ANISOTROPY OF THE ONE-THIRD DAY VARIATION OF COSMIC RAY. Kanno, T. (Fukushima Univ., Japan); Ishida, Y.; Saito, T. Uchusen Kenkyu; 18: No. 1, 127-136(Aug 1973). (In Japanese).

Anisotropy of the one-third day variation of cosmic ray was investigated by analyzing the data taken at Deep River and Ottawa. The results of analysis of the data at Deep River show that the time of the maximum one-third day variation of cosmic ray neutron intensity Tmn^3 is in the direction of 1 h in the space, that the yearly average value of the vector sum of Tmn^3 ($\langle Tmn^3\rangle_Y$) shows correlation with solar activity, that the secular variation of Tmn^3 is observed, and that the anisotropy was in the direction of 5 h in 1962 and in the period from 1968 to 1971, and in the direction of 1 h in the period from 1963 to 1967. The data at Ottawa show that the anisotropy is seen in two directions of 5 h and 1 h in the space, that the tendency of $\langle Tmn^3\rangle_Y$ is similar to that at Deep River, and that the secular variation is also seen. By combining other data, it can be said that the anisotropy of the one-third day variation of cosmic ray neutron intensity is seen in the direction of 1 h or 5 h on an average, that the secular variation is observed in the anisotropy, and that correlation is seen between $\langle Tmn^3\rangle_Y$ and the intensity of the green line of solar corona spectrum. (JA)

1368 DAILY VARIATION OF THE UNDERGROUND COSMIC RAY AT TAKEYAMA. Murakami, K. (Inst. of Physical and Chemical Research, Wako, Japan); Wada, M.; Mishima, Y. Uchusen Kenkyu; 18: No. 1, 137-140(Aug 1973). (In Japanese).

The intensity of cosmic radiation is observed at Takeyama at the depth of 54 m. The observed components are the vertical, 30° zenith angle, and 50° zenith angle components in each direction of east, west, south and north. The average daily variation of the vertical and the 30° components for the period from 1970 to 1972 are graphically shown in this paper. The daily variation corrected for atmospheric pressure, the half-day variation, and the one-third day variation are shown. Because of lack of statistical accuracy, it is hard to deduce any conclusion at present. The analysis is in progress. (JA)

1369 SPHERICAL ZONAL COMPONENTS OF COSMIC RAYS IN INTERPLANETARY SPACE. Takahashi, H. (Iwate Univ., Morioka, Japan); Yahagi, N.; Nagashima, K. Uchusen Kenkyu; 18: No. 1, 106-112(Aug 1973). (In Japanese).

The formulation of analysis of three dimensional cosmic ray anisotropy in interplanetary space has been given by K. Nagashima (Rep. Ionos. Space Res. Japan; 25: 189(1971)). The results of analysis on the zonal harmonic component of cosmic ray by using the above mentioned formulation are reported in the present paper. The analyzed data were taken during the period between Sep. 6 and Sep. 12, 1964, the period between March 25 and Apr. 9, 1958 and the period between Feb. 9 and Feb. 18, 1958. Two types of differential rigidity spectra, namely power type and power exponential type, were used for the analysis. The results of analysis are shown, and are compared with the data of the neutron intensity at Deep River. The variation of isotropic components was similar to the variation of neutron intensity at Deep River. However, it is too hasty to make any conclusion, since the number of data is scarce at present. (JA)

1370 POWER SPECTRUM OF THE COSMIC RAY INTENSITY VARIATIONS. Fujii, Z. (Nagoya Univ., Japan). Uchusen Kenkyu; 18: No. 1, 71-78(Aug 1973). (In Japanese).

The short period variation of cosmic radiation with periods between one day and six minutes, observed at Mt. Norikura, is investigated. The three minute data taken from Jan. to March 1971 were analyzed by the power spectrum analysis method. The contribution of the variation of atmospheric pressure was studied. The contribution to the power spectrum of cosmic ray intensity variation was negligible in case of the period shorter than one or two hours. White noise was considered for the analysis. The frequency (f) dependence of the power spectrum of cosmic ray intensity variation was $f^{-1.7}$ for the period from several hours to about ten minutes. Any significant peak except the higher harmonics to the third order of daily variation cannot be observed. It was found by simulation that the higher harmonics of variation with the period longer than one day made a large contribution to the power spectrum of the cosmic ray intensity variation. Further investigation into the cause of the variation is in progress. (JA)

1371 TRANSVERSE MOMENTUM DISTRIBUTION OF SECONDARY π^0 MESONS IN AIR JET. Nishio, A. (Kyoto Univ.). Uchusen Kenkyu; 17: No. 4, 363-369(Feb 1973). (In Japanese).

From symposium on charged particles and cosmic radiation; Hamamatsu, Japan (Dec 1971).

Analysis of transverse momentum distribution as an integral spectrum of the secondary π^0 mesons in air jet was performed. Representation of the distribution functions used was the integral spectrum, and adopted distributions were Planck distribution (PD), linear exponential distribution (LD), Boltzmann distribution (BD), KD type distribution (KD), and two gaussian type distributions (two BD). The data analyzed were taken at Mt. Norikura with emulsion chambers. The criteria for the selection of data are that events occurred below 1000 m of elevation and number of gamma-ray is more than 5. The transverse momentum distribution (P^2t) of $\Sigma Pt\gamma \leq 2.5$ GeV/c, $\Sigma E\gamma \leq 20$ TeV and $N\gamma > 5$ was investigated. Then, the distribution (P^2t) of $N\gamma > 5$ and $\Sigma Pt\gamma > 2.5$ GeV/c was studied. The results of present study showed that good agreement with the data was obtained by LD with $\mu C^2/kT = 1.1$ in case of $\Sigma Pt\gamma \leq 2.5$ GeV/c. Good agreement was also obtained by PD with $\mu C^2/kT = 1.3$, and by KD with $\mu C^2/kT = 1.3$. However, agreement with BD and two BD was not so good. In case of $\Sigma Pt\gamma > 2.5$ GeV/c, number of data was small. It seems that BD shows good agreement up to $Pt^2 < 0.4$ (GeV/c)^2. (JA)

1372 PARKES 2700 MHz SURVEY (SIXTH PART) CATALOGUE FOR THE DECLINATION ZONE −30° TO −35°. Shimmins, A. J.; Bolton, J. G. (CSIRO, Epping, Australia). Aust. J. Phys., Astrophys. Suppl.; No. 32, 1-55(May 1974).

A catalog of 939 extragalactic radio sources obtained from a sky survey at 2700 MHz is presented. The area surveyed is between declinations −30° and −35°, and covers all right ascensions except for two regions within approximately 10° of the galactic plane. For an area of 0.390 sr, the catalog is complete to a limiting flux density of 0.18 f.u. at 2700 MHz (~1100 sources per steradian) and is thought to be at least 90% complete at a flux density of 0.15 f.u. (~1400 sources per steradian). The positions are accurate to 18″ arc in both coordinates for sources with $S_{2700} \approx 0.18$

f.u. and 13″ arc for the stronger sources; the flux densities are accurate to $[0.02^2 + (0.030S)^2]^{\frac{1}{2}}$ f.u. Flux densities at 5009 MHz have been measured for 291 of the strong sources. Identifications with galaxies have been made for 80 of the sources, 26 sources have been confirmed as quasi-stellar objects and a further 39 are suggested as possible quasi-stellar objects. (auth)

1373 VARIATIONS OF THE COSMIC-RAY INTENSITY AND K_p DATA IN THE SOLAR ACTIVITY CYCLE NO. 19. Filisetti, O.; Lovera, G.; Oldano, C.; Tedde, P. G. (Istituto di Fisica Sperimentale del Politecnico, Turin). Lett. Nuovo Cim.; 11: No. 1, 29-32(7 Sep 1974).

The preliminary results of a detailed analysis of the quasi-periodic variations of the cosmic ray intensity having either a 20-day period or shorter periods (about 12 or 6 days) covering a complete cycle of solar activity ranging between two successive minima of the solar activity are presented. The same analysis was extended to the variations of the international planetary index K_p, assumed as a measure of the geomagnetic activity. One purpose of this investigation is to correlate these variations with the sunspot number behavior which is commonly used to characterize the solar activity. (JFP)

1374 COSMIC RAY VARIATIONS DURING AUGUST 3–10, 1972. Kodama, M.; Murakami, K.; Wada, M. (Inst. of Physical and Chemical Research, Tokyo). Rep. Ionosphere Space Res. Jap.; 27: No. 4, 161-162(1973).

The variation in cosmic ray intensity, which was observed at the time of the high activity of the sun in early August 1972 and should be studied in detail, is described in this paper. The variation includes (1) slight pre-increase around 21 UT on August 3, (2) the anisotropic onset of Forbush decrease associated with the ssc at 0119 UT on August 4, (3) small increase around 6 ~ 9 UT on August 4, (4) increase with the time of maximum at 1400 ~ 1500 UT on August 4, which might be due to the flare at 0617 UT and 8° east, (5) small increase around the ssc given above, of which the spectrum is of usual Forbush decrease, (6) large decrease with the minimum at 0100 UT on August 5, of which the spectrum is not unusual as compared with average Forbush decrease, (7) increase or rapid recovery at 0300 ~ 0500 UT on August 5, which coincided with the square-shaped increase of solar protons outside magnetosphere, (8) the recovery from the Forbush decrease, which is monotonic, and almost disappeared in the middle of August, (9) the ground level event with maximum at 1600 ~ 1700 UT on August 7, of which the source was the flare at 1449 UT on August 7, at 37° west, and (10) the Forbush decrease associated with the ssc of 1254 UT on August 8, which was a small and dull decreasing event. (JA)

Stars

1375 (AD-778932) RECENTLY SYNTHESIZED r-PROCESS NUCLEI: ULTRA-HEAVY COSMIC RAYS AND PECULIAR STARS. Report for 1 October 1973–1 January 1974. Blake, J. B.; Schramm, D. N. (Aerospace Corp., El Segundo, Calif. (USA)). 19 Apr 1974. Contract F04701-73-C-0074. 37p. (SAMSO-TR-74-102). NTIS $3.25.

Recently synthesized ($T \lesssim 1$ billion years) r-process material has actinide elemental and isotopic abundance characteristics which can be used to distinguish it from ancient r-process material. The time dependence of relative actinide abundances provides detailed chronometric information. Also, it is shown that, if N = 184 is a neutron magic number as predicted by nuclear theory, the resulting r-process production peak at $A \approx 281$ will in turn yield, due to symmetric fission, a broad abundance peak around $A \approx 135$ to 140. The present results can be used to help verify or refute some current hypotheses concerning the origin of UH cosmic rays and some of the abundance anomalies in peculiar stars. (auth)

1376 (COO-3071-98) ANTINEUTRINO PULSES EXPECTED FROM VIBRATIONS OF A NEWLY FORMED HOT NEUTRON STAR. Bludman, S. A.; Cohen, J. M.; Lande, K. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). Jun 1974. 13p. (UPR-0031T). Dep. NTIS $4.00.

The data presented recently by Lande, et. al. has to do with the time structure of the antineutrinos apparently received from an extraterrestrial source. At least four microsecond bursts separated by 0.640, 0.968, and 0.928 ms. were observed. If these bursts originated in an isotropically emitting source near the galactic center (~10 Kpo), then about 3×10^{52} ergs is contained in each ms burst. It is shown that the approximately millisecond period is characteristic of matter at high density, $\rho \gtrsim 2 \times 10^{13}$ gm/cc, and the microsecond burst width is characteristic of an extremely temperature- and density-dependent emission mechanism and a mean free path ~10^5 cm characteristic of high-energy antineutrinos in dense matter. The energy per pulse and number of pulses is what would be expected in the gravitational collapse of a white dwarf core to a radially pulsating hot neutron star. (auth)

1377 (ORO-3992-185) REALISTIC LOWER BOUND FOR THE MAXIMUM MASS OF NEUTRON STARS. Bowers, R. L.; Pedigo, D.; Gleeson, A. M.; Zimmerman, R. L. (Texas Univ., (USA). Center for Particle Theory). May 1974. 16p. (CPT-229). Dep. NTIS $4.00.

An improved equation of state for neutron matter which includes relativistic pion exchange is used to calculate neutron star masses and moments of inertia. The equation of state sets a reasonable lower bound on the softness of cold superdense matter, and leads to a maximum equilibrium neutron star mass of $0.52M_\odot$. Processes which could effect our conclusions such as hyperionization, non-normal ground states, solidification, and local anisotropy are discussed. (auth)

1378 (RRK-73-6) GRAVITATIONAL COLLAPSE OF A ROTATING STAR. 2. Exterior Field of a Slowly Rotating Collapsing Star. Tomita, K. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Apr 1973. 14p. NTIS (US Sales Only).

The gravitational exterior field outside a slowly rotating collapsing star is examined. The final field in the course of the collapse is shown to be expressed by a stationary metric which is exactly Kerr's metric, and the other nonstationary parts of the metric damp away in a power law at large time. The case of rapid rotation is also discussed. (auth)

1379 STRUCTURE AND DYNAMICS OF STELLAR SYSTEMS. II. Idlis, G. M.; Karyagina, Z. V.; Rozhkovskii, D. A.; Fesenkov, V. G.; Pyaskovskaya-Fesenkova, E. V.; Omarov, T. B.; Livshits, G. Sh. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 12: 3-149(1969). (In Russian).

A critical review is given of studies published in the last 10 years, and new studies are presented on various problems of the structure and dynamics of real stellar systems (especially galaxies): analysis of factual data, possibilities of modeling and explaining the basic properties, and the evolution of typical stellar systems. (SJR)

1380 STUDY OF MAGNESIUM II AND HELIUM I IN THE SPECTRA OF EARLY TYPE STARS. Snijders, M. A. J. Groningen, Netherlands; Rijksuniversiteit (1974). 98p. Thesis.

Profiles of He I 4471 predicted by various authors using model atmospheres and recent theory of the Stark broadening of He I are compared with published profiles in B stars and with some newly acquired profiles. Systematic differences occur which indicate that the hypothesis of LTE is untenable for computing the formation of He I lines. The total equivalent width of the Mg II lines λ2795.5, λ2802.7 ($3s^2S$-$3p^2P^0$) and λ2790.8, λ2798.0 ($3p^2P^0$-$3d^2D$) has been measured in the spectrograms of 31 stars. The equivalent widths of the ultraviolet Mg II lines from the 3s-3p and 3p-3d transitions in the spectra of 96 stars and of the visual lines from the 3d-4f transition in 53 stars of types O4 to A3 are presented. The equivalent widths and profiles of these Mg II lines are computed in a grid of model atmosphere with $8000 \leq T_{eff} \leq 35000$ K and $2.5 \leq \log g \leq 4.0$, by means of a Non-LTE theory of line formation and assuming an Mg/H ratio of 3×10^{-5}. The effects of the various physical assumptions on the strength of the Mg II lines are discussed. The lines are sensitive to the amount of UV-blanketing in the atmospheres of types B5 and later. (NL)

1381 ENERGY DISTRIBUTION IN EARLY K-STARS. Chaturvedi, J. P.; Sinvhal, S. D. (Uttar Pradesh State Observatory Naini Tal, India). Astrophys. Space Sci.; 29: No. 2, 427-434(Aug 1974).

The spectral distribution of energy for 21 early K-stars in the wavelength region 450 nm to 750 nm at a definition of 5 nm have been obtained. A two dimensional photometric spectral classification index-system for these stars has been devised and discussed. (auth)

1382 THREE-COLOUR PHOTOMETRY OF GH PEGASI. Srivastava, R. K.; Padalia, T. D. (Uttar Pradesh State Observatory, Naini Tal, India). Astrophys. Space Sci.; 29: No. 2, 435-438(Aug 1974).

The eclipsing binary GH Pegasi (=BD + 14°4684 = HD 207741) was discovered by Strohmeier and Knigge. The system was observed by Filatov (1961) and a photographic light curve was given by Strohmeier (1962). The geometrical elements of the system GH Pegasi and a slightly improved period of 2.556136d have been given. (auth)

1383 LINE STRENGTHS FOR YELLOW SUPERGIANTS AND CEPHEIDS. Schmidt, E. G. (Royal Greenwich Observatory,

Hailsham (UK)); Rosendhal, J. D.; Jewsbury, C. P. (Arizona Univ., Tucson (USA)). Astrophys. Space Sci.; 29: No. 2, 397-414(Aug 1974).

Line strengths are presented for 15 yellow supergiants and 6 Cepheids. These line strengths are compared with those obtained previously by other investigators. (auth)

1384 THE METALLIC-LINE STAR HD 153286. Engin, S. (Ankara Univ. (Turkey)). Astrophys. Space Sci.; 29: No. 2, 343-378(Aug 1974).

The spectrum of the metallic-line and magnetic star HD 153286 has been studied. The line intensity is constant within the limit of the errors, while the radial velocity is slightly variable. A differential analysis by means of the curve-of-growth method has been made, using 5 and, F5 V as standard star. Moreover, an atmospheric model has been computed; the results of the fine analysis indicate a defect of Sc by a factor of 30 and a defect of Ca by a factor included between 4 and 25; Si, Ti, V, Cr and Fe are normal, Mn, Co, Ni in slight excess by factors included between 2 and 5, Sr, Y, Zr, Ba and La are in excess by factors lower than 10; Ce, Nd and Sm are almost normal; Eu and Gd are in excess by factors of 250 and 4, respectively. These results are compared with the predictions of the diffusion theory. (auth)

1385 HYDROMAGNETIC STABILITY OF A COMPRESSIBLE PLASMA WITH HALL-CURRENTS. Ariel, P. D. (Malaviya Regional Engineering Coll., Jaipur (India)). Astrophys. Space Sci.; 29: No. 2, 319-329(Aug 1974).

The hydromagnetic stability of an electrically conducting compressible plasma having variable density in the vertical direction has been investigated taking into account the effects of Hall-currents. The solution is shown to be characterized by a variational principle. Based on the existence of variational principle, the dispersion relation has been obtained for the case of a plasma having exponentially varying density with special reference to stellar atmosphere. It is found that both compressibility of the medium and Hall-currents destabilize the configuration for the disturbances, for which it was stable otherwise. The Hall-currents even suppress the mode of maximum instability for large magnitudes. (auth)

1386 ENVELOPE DYNAMICS OF IRON-CORE SUPERNOVA MODELS. Barkat, Z. (Cornell Univ., Ithaca, N. Y. (USA). Center for Radiophysics and Space Research); Wheeler, J. C. (Harvard Coll. Observatory, Cambridge, Mass. (USA)); Buchler, J.-R. (Yeshiva Univ., New York (USA). Belfer Graduate School of Science); Rakavy, G. (Hebrew Univ., Jerusalem (Israel)). Astrophys. Space Sci.; 29: No. 2, 267-283(Aug 1974).

Wilson has found that the neutrino transport mechanism is unable to generate a supernova explosion in stars with collapsing iron cores. Wilson's analysis was utilized to investigate the behavior of the overlying potentially explosive layers which Wilson omitted. The outer boundary of the core of Wilson's moves in such a manner as to deliver a shock to the base of the envelope. The progress of such shocks was followed numerically into the envelope of a realistic model obtained from evolutionary calculations. It was found that only shocks so strong as to be inconsistent with the treatment are capable of ejecting material. For reasonable shocks the nuclear burning does not proceed rapidly at densities below $Q \sim 10^6$ g cm^{-3} and the nuclear energy released is less than the shock energy in all models that come near to ejecting matter. The initial model adopted here, which is based on a particular set of evolutionary calculations and which neglects rotation and magnetic fields, seems destined to generate a black hole. The creation of a black hole in such a way is probably not attended by a supernova explosion. (auth)

1387 VARIABLE SPECTRUM OF THE SHELL STAR BD + 60°606. Cowley, A. P. (Dominion Astrophysical Observatory, Victoria, B. C.); Conti, P. S. Publ. Astron. Soc. Pac.; 86: No. 512, 558-559(Aug 1974).

BD + 60°606 (MWC 59) is found to be a rapidly rotating B5e star with a variable shell spectrum. Scattered observations over the past 20 years show pronounced spectral changes. (auth)

1388 NECROLOGY OF THE HYADES CLUSTER. Tinsley, B. M. (Univ. of Texas, Austin). Publ. Astron. Soc. Pac.; 86: No. 512, 554-557(Aug 1974).

The number of white dwarfs in the Hyades cluster is compared with the number of stars expected to have died during the lifetime of the cluster, in different mass intervals above the present turn-off mass. The uncertainties (mostly statistical, so not likely to be resolved) preclude the possibility of making a significant estimate of the upper mass limit for stars that die as white dwarfs. This limit is of theoretical importance in relation to such problems as carbon detonation and pulsar formation. (auth)

1389 1973 PALOMAR SUPERNOVA SEARCH. Kowal, C. T.; Zwicky, F.; Sargent, W. L. W.; Searle, L. (Carnegie Institution of Washington, DC). Publ. Astron. Soc. Pac.; 86: No. 512, 516-525 (Aug 1974).

Sixteen supernovae were discovered at Palomar Observatory during 1973; twelve during the monthly supernova search on the 48-inch Schmidt telescope, and four on plates taken for other purposes. In addition, 22 supernovae were found on old plates of the Palomar Sky Survey. (WDM)

1390 SHORT-PERIOD VELOCITY VARIATIONS IN HD 152667. Hill, G. (Dominion Astrophysical Observatory, Victoria, B. C.); Crawford, D. L.; Barnes, J. V. Publ. Astron. Soc. Pac.; 86: No. 512, 477-479(Aug 1974).

Recent spectroscopic data, based on plate material gathered at the Cerro Tololo Inter-American Observatory, confirm the short period (0.61470 day) velocity changes seen in HD 152667 by Walker (1971). The possibility that this P Cygni star is also a β Cephei star is discussed. (auth)

1391 HAFFNER 20 AND 21, TWO MODERATELY OLD OPEN CLUSTERS IN PUPPIS. Fitzgerald, M. P.; Moffat, A. F. J. (Ruhr-Univ., Bochum, Ger.). Publ. Astron. Soc. Pac.; 86: No. 512, 480-485(Aug 1974).

Photographic UBV photometry is presented for 33 and 51 stars in the regions of Haffner 20 ($l = 247.0°$, $b = -1.0°$) and Haffner 21 ($l = 244.8°$, $b = +1.6°$), respectively. Both are moderately old (earliest spectral type b9), small (diameter 2.2') open clusters in Puppis. Haffner 20 lies at a distance of 2.4 ± 0.3 kpc, and Haffner 21 at 3.3 ± 0.4 kpc. The low reddening of Haffner 21 ($E_{B-V} = 0.20$) and the higher reddening of Haffner 20 ($E_{B-V} = 0.55$) reflect the tendency of interstellar dust to lie below the galactic plane in Puppis. (auth)

1392 MAGNETIC NULL LINES OF ASTROPHYSICAL INTEREST. II. Adelman, S. J. (Goddard Space Flight Center, Greenbelt, MD). Publ. Astron. Soc. Pac.; 86: No. 512, 486-489(Aug 1974).

A list of magnetic null lines from selected spectroscopic analyses is presented for possible use in the detailed studies of magnetic Ap stars. (auth)

1393 SEARCH FOR SPECTROSCOPIC BINARIES FROM PUBLISHED RADIAL VELOCITY DATA. Morbey, C. L.; Brosterhus, E. B. (Dominion Astrophysical Observatory, Victoria, B. C.). Publ. Astron. Soc. Pac.; 86: No. 512, 455-460(Aug 1974).

The published radial velocities for a sample of ten suspected spectroscopic binaries were analyzed by means of a computerized period-finding method capable of examining more than 150,000 periods hour^{-1} on modern fast computers. The investigation is intended to provide an indication of the possible usefulness of a similar program on a larger scale, including all those suspected binaries for which seemingly good and sufficient observations have not led to satisfactory periods. A definite answer emerged for four stars. Orbital elements were found for two stars and two showed no periodic variation in velocity. The other six stars require additional observations to reach a definitive conclusion. (auth)

1394 INTERESTING GROUP OF EMISSION-LINE STARS IN SCORPIUS. Sanduleak, N. (Case Western Univ., Cleveland). Publ. Astron. Soc. Pac.; 86: No. 512, 461-463(Aug 1974).

An objective-prism survey of the southern Milky Way has detected three and possibly four emission-line stars at $l = 348.7°$, $b = -0.8°$ which appear to constitute a physical group located about 2 kpc from the Sun. Two stars are provisionally classified as WN + OB and a third appears to be Of. (auth)

1395 IDENTIFICATIONS AND SPECTRA OF INFRARED OBJECTS. Wydckoff, S.; Wehinger, P. (Tel-Aviv Univ., Israel). Publ. Astron. Soc. Pac.; 86: No. 512, 464-469(Aug 1974).

Thirty-six infrared objects were identified from direct two-color image-tube photographs. Slit spectra in the 5800 Å to 8800 Å region were obtained of each object. The sample consists of 35 M-type stars, one carbon star, and no S-type stars. Most of the M stars are probably semiregular and Mira-type variables. (auth)

1396 IRC + 60370 AND THE INFRARED RADIATION FROM LUMINOUS G AND K SUPERGIANTS. Humphreys, R. M.; Ney, E. P. (Univ. of Minnesota, Minneapolis). Publ. Astron. Soc. Pac.; 86: No. 512, 444-447(Aug 1974).

IRC + 60370 (K0: Ia) was observed to have large silicate emission features at 11 μ and 18 μ similar to the very luminous star HR 5171a (G8 Ia-0). The other G and K supergiants observed have less excess radiation attributed to silicates. In W Cep (K0 epIa + O) the infrared radiation between 1.5 μ and 6 μ has the same slope as free-free emission plus a small silicate feature. (auth)

1397 SPECTRA OF SN 1972e, IN NGC 5253. Bolton, C. T.; Garrison, R. F.; Salmon, D.; Geffken, N. (David Dunlap Observatory, Richmond Hill, Ont.). Publ. Astron. Soc. Pac.; 86: No. 512, 439-443(Aug 1974).

Wavelengths of features in the spectrum of SN 1972e in NGC 5253 derived from 14 blue spectra taken between 19 and 260 days after maximum light are given and the evolution of the spectrum is discussed. (auth)

1398 CLUMP OF M STARS IN VELORUM–CARINA. Eggen, O. J. (Mount Stromlo Observatory, Canberra, Australia). Publ. Astron. Soc. Pac.; 86: No. 512, 429-438(Aug 1974).

An apparent clump of M type, HD stars on the border of Carina and Velorum probably results from a rift in the absorption with E(B–V) rising to only 0.1m at 2 kpc. The 18 M-type stars in the rift contain 13 new variables of the small-amplitude, semi-periodic type. (auth)

1399 ATMOSPHERIC MOTIONS IN RED SUPERGIANTS. Brooke, A. L.; Lambert, D. L.; Barnes, T. G. III. (Univ. of Texas, Austin). Publ. Astron. Soc. Pac.; 86: No. 512, 419-428 (Aug 1974).

Radial velocities obtained from interferometric spectra of α Ori, α Her, and α Sco were analyzed to investigate expansion and other large-scale motions in their atmospheres. In α Ori evidence of such motions was found. They appeared to be sporadic in time or position on the surface of the star. If these motions are an observational indication of mass loss, they lead to extremely high instantaneous loss rates. It has not been possible to infer an average rate of mass loss. (auth)

1400 SPECTRUM VARIATIONS IN THE Ap-TYPE STARS. I. A Survey of Stars Between 7^h and 19^h Right Ascension. Bonsack, W. K. (Univ. of Hawaii, Honolulu). Publ. Astron. Soc. Pac.; 86: No. 512, 408-418(Aug 1974).

Repeated spectrographic observations at dispersions of 11 Å and 17 Å mm^{-1} were made of 29 Ap stars located between right ascensions 7^h and 19^h , and north of declination –40°. Manganese-type Ap stars were excluded from the survey. The Ap classification of seven of the stars was not confirmed, but of the remaining 22, exactly half proved to be spectrum variables, on the basis of visual inspection of the spectrograms. Equivalent-width measurements were made for the spectrum variables in order to provide quantitative indicators of variability. Examination of the Ap stars in Babcock's list of magnetic stars shows that of those sufficiently well observed to determine variability, 47% are spectrum variables, in agreement with the results of the present observations. The data available are insufficient to determine correlations between the type and degree of spectrum variability and the other properties of the Ap stars. (auth)

1401 UNUSUAL RR LYRAE-TYPE VARIABLE. Przybilski, A.; Bessell, M. S. (Mount Stromlo Observatory, Canberra, Australia). Publ. Astron. Soc. Pac.; 86: No. 512, 403-407(Aug 1974).

The high-velocity star HD 202759 is a variable star with an irregular amplitude of about 0.08m and a quasi-period of about 12 hours. Its surface gravity, log g is 3.1 and its effective temperature 7400°K. It is probably an RR Lyrae star close to the blue edge of the instability strip. (auth)

1402 NATURE OF V751 CYGNI. Robinson, E. L. (Univ. of California, Santa Cruz); Nather, R. E.; Kiplinger, A. Publ. Astron. Soc. Pac.; 86: No. 512, 401-402(Aug 1974).

High-speed photometry of the peculiar variable V751 Cyg shows it to display rapid variations, or flickering, similar to that of the cataclysmic variables. V751 Cyg is similar in every respect to VY Scl, and belongs to a very small group of cataclysmic variables which now includes VY Scl, UX UMa, and CO –42° 14462. These stars appear to be dwarf novae which are continuously or nearly continuously erupting. (auth)

1403 FAINT OB STARS BEHIND THE COALSACK. Muzzio, J. C.; Marraco, H. G.; Feinstein, A. (Univ. Nacional de La Plata). Publ. Astron. Soc. Pac.; 86: No. 512, 394-400(Aug 1974).

An investigation of OB stars in the Coalsack region is done by means of UBV photographic photometry. The study includes previously known OB stars within a 1° radius circle centered at l = 302.4°, b = –0.2°, and newly discovered faint OB stars in five small areas (80 square arc minutes each) within the same circle. Total visual absorption values and minimum distance moduli are derived for all the stars, and the absorption vs. distance modulus diagram is presented. A possible distant OB association is noted in the region surrounding the compact cluster Hogg 15. (auth)

1404 ORBITAL PERIOD AND LIGHT CURVE VARIATIONS OF THE BINARY SYSTEM RS CANUM VENATICORUM. Catalano, S.; Rodono, M. (Univ., Catania, Italy). Publ. Astron. Soc. Pac.; 86: No. 512, 390-393(Aug 1974).

The orbital period and the light-curve variations of the binary system RS CVn are rediscussed according to a long series of photometric observations made at Catania Observatory since 1963. The period of the migrating wave-like distortion on the light-curve outside eclipses and its role in determining the photometric variations during eclipses are examined. The results obtained make quite improbable Hall's explanations of the erratic changes of the orbital period. (auth)

1405 COMPARISON OF INTERSTELLAR Na I, Ca II, AND K I ABSORPTION. Hobbs, L. M. (Univ. of Chicago). Astrophys. J.; 191: No. 2, 381-393(15 Jul 1974).

The column densities of interstellar Na I, Ca II, and K I derived from interferometric scans of the optical absorption lines are compared comprehensively with each other, and with distance d, reddening E(B–V), and hydrogen column density N(H I) derived from the Lα line. The quantities N(Na I), N(K I), N(H I), and E(B–V) are mutually well correlated, to better than a factor of two. In contrast, the quantity N(Ca II) is discrepant, showing a much poorer correlation with each of the prior quantities. This result may indicate appreciable variations in the apparently large depletion of calcium from the interstellar gas. Quantitative, nonlinear mean relations are established among the well correlated quantities, and the resulting Na, K, and Ca abundances are estimated. Ionization of Na I by charge exchange with C II seems negligible compared with photoionization. (auth)

1406 NOVA DELPHINI 1967. I. SPECTROSCOPIC OBSERVATIONS. Sanyal, A. (Department of Astronomy, University of Texas at Austin). Astrophys. J. Suppl. Ser. 28: No. 257, 115-145 (June 1974).

Spectroscopic observations of Nova Delphini 1967 have been made during the period 1967 July–1969 August with the coudé spectrographs of the 107–inch (2.7–m) and 82–inch (2–m) telescopes at the McDonald Observatory. The spectral range covered was λλ4000–9000. The dispersion used varied from 2.2 to 50 Å mm^{-1}. The development of the spectrum through the nebular stage and its correlation with the light curve are discussed. Some of the McLaughlin classes of spectral development have been identified. Radial velocities of various spectral features have been determined. Evidences for the presence of circumstellar matter around the nova are discussed. The He I λ 10,830 line was photographically detected and the role of circumstellar matter in determining its shape is discussed. The distance of the nova has been estimated by three methods; (a) equivalent width of the Ca II K–line, (b) rate of decline of the light curve, and (c) interstellar reddening determined from helium and hydrogen line intensity ratios. The possibility that a collision of two clouds could have caused the 1967 December 12 brightening is discussed. (auth)

1407 V1016 CYGNI: SPECTRAL OBSERVATIONS 1969–1973. Fitzgerald, M.P.; Pilavaki, A. (Astronomy Program, Department of Physics, University of Waterloo). Astrophys. J. Suppl. Ser. 28: No. 258, 147-155 (June 1974).

Spectroscopic observations of V1016 Cygni made between 1969 and 1973 are presented. Identifications and log intensities are given for about 245 (120 newly reported) emission lines. The general appearance of the strong lines is about the same, implying that the conditions in the emitting regions have changed little. Parts of the nebula are slightly more ionized and less dense, as is evidenced by the appearance or strengthening of lines of [Ne IV], [Ne V], [Ar IV], [Ar V], [Fe III], [Fe IV], and [Fe VI]. The permitted iron lines have faded completely. The electron density remains at 10^6–10^7 cm^{-3}, as is evidenced by the continued strength of [O III] λ4363 and weakness of [O II] λλ3726 and 3729. The detection of 16 or more weak emission lines of Al II is reported. The emitting region is complex and nonsymmetrical. The maintenance of high density in an expanding region (at 34 km s^{-1}) implies a continued outflow of material from the star. The violet wing of the emission lines is evidence for such a flow at 105 km s^{-1}. A model of the system is presented, explaining the radio, optical, and infrared components, in terms of a disk population object located 2400 pc away, which is in the process of becoming a planetary nebula. (auth)

1408 THEORY OF WHITE DWARFS. Saakyan, G. S.; Sedrakyan, D. M.; Chubaryan, E. V. (Erevan State Univ.). Astrophysics (Engl. Transl.); 8: No. 4, 317-325(1972).

Translated from Astrofizika; 8: No. 4, 541-556(1972).

The additional gravitational energy due to a certain distension of rotating white dwarfs is of the order of $10^{50}(\Omega/\Omega_m)^2$ ergs, where Ω is the angular velocity of rotation and Ω_m is its maximal possible value for the given configuration. With gradual slowing down, the star contracts and this energy is liberated in the entire volume in the form of heat. If Ω is not too small compared with Ω_m, this reserve of energy can provide a luminosity that is not only of the order of the solar luminosity but even higher over a period of time of the order of cosmogonic times. If $x_0 \gtrsim 1$ and $T_0 \sim 6 \cdot 10^8$, a white dwarf can have an extended atmosphere with mass $M \sim 10^{31}$ g, radius $R \sim 0.1$ parsec, and surface temperature $T_e \approx 685$. (auth)

1409 STABILITY OF ROTATING SPHEROIDS MADE PROLATE BY A TOROIDAL MAGNETIC FIELD. Oganesyan, R. S.;

Abramyan, M. G. (Erevan State Univ.). Astrophysics (Engl. Transl.); 8: No. 4, 352-358(1972).

Translated from Astrofizika; 8: No. 4, 599-608(1972).

A study is made of the stability of rotating liquid spheroids made prolate by a toroidal magnetic field. Stability against small surface perturbations of the mode n = m = 2, which is decisive in the theory of liquid figures, is considered. It is shown that such spheroids are stable configurations. (auth)

1410 FLARE STARS IN THE PLEIADES. III. Ambartsumyan, V. A.; Mirzoyan, L. V.; Parsamyan, E. S.; Chavushyan, O. S.; Erastova, L. K.; Kazaryan, E. S.; Oganyan, G. B. (Astrophysical Observatory, Moscow). Astrophysics (Engl. Transl.); 8: No. 4, 287-299(1972).

Translated from Astrofizika; 8: No. 4, 485-508(1972).

The results are given of observations of stellar flares. These were made at the observatories at Byurakan and Asiago during essentially two seasons—1970/1971 and 1971/72. Altogether, 76 new flare stars were discovered together with 74 flare repetitions of known flare stars. Some of these flares were discovered on plates from an earlier period. The total number of flare stars in the Pleiades has reached 291, and the number with repeated flares has reached 168. (WDM)

1411 BLACK HOLES AS THE FINAL STATE IN THE EVOLUTION OF MASSIVE BODIES. Carter, B. (Cambridge Univ., Eng.). J. Phys. (Paris), Colloq.; No. 7, 39-47(1973).

From centenary congress of the French Physical Society; Vittel, France (28 May 1973).

According to present understanding of Einstein's theory of gravity the field outside a black hole should be expected to settle down towards a well defined equilibrium state. The form of this final state is described by the solution of Kerr; and it depends only on the mass and angular momentum of the hole. A black hole in or near equilibrium should have a mechanical behavior closely analogous to that of an ordinary visco-elastic body. Observationally black holes are, by their nature, very difficult to detect directly. The presence of a black hole would be revealed by its gravitational effect on a nearby directly visible body, as in a binary system, but this effect would not necessarily distinguish a black hole from any other kind of object above this critical mass but with relatively low luminosity. However a black hole could also be revealed in a more characteristic manner by radiation produced by infalling matter from the surrounding medium. Both criteria are satisfied by the recently discovered x-ray source Cygnus X-1, which therefore appears to be the first convincing case of the observational detection of a black hole. (FR)

1412 CHARACTERISTIC NUCLEAR RADIATION FROM THE GALACTIC CENTRE. Kuchowicz, B. (Univ. of Warsaw). Urania (Krakow); 44: 214-215(1973). (In Polish).

Several years ago attention was put on the possibility of observing gamma spectra from the supernova remnants. The gamma rays may be attributed to the several successive nuclides from radioactive decay chains originating in rapid nucleosynthesis. Three years ago a sharp 470 keV line from the direction of the center of our Galaxy was detected. This result was confirmed recently with the help of lunar occultation method. One does not know still whether this may be relevant to the problem of a hitherto hypothetical nucleosynthesis in galactic nuclei. (auth)

1413 LINEAR SERIES OF STELLAR MODELS. III. Hydrogen–Helium Star of 10 $M_{\odot}$. Kozlowski, M. (Univ. of Warsaw); Paczynski, B. Acta Astron.; 23: 65-77(1973).

Two linear series of models for a star of 10 $M_{\odot}$ are constructed. Models consist of hydrogen rich envelopes and helium rich cores. The two series have somewhat different profile of hydrogen distribution. Each series has two terminating points, one on the hydrogen main sequence, and the second on the helium main sequence. The first series has eight, and the second series has twelve turning points, where the helium core mass reaches an extremum. These points separate stable and unstable branches of the linear series. Helium flash phenomenon is interpreted as a result of stellar model reaching a turning point of a linear series. Up to nine different models are effectively constructed for a given mass of the helium core. (auth)

1414 STATIONARY MASS OUTFLOW FROM STARS. II. The Results for 30$M_{\odot}$ Star. Zytkow, A. (Inst. of Astronomy, Warsaw). Acta Astron.; 23: 121-134(1973).

Models of spherically symmetric, stationary outflowing stellar envelopes with radiation pressure in continuum as the main driving force constructed for a 30 $M_{\odot}$ star by means of integrations of the equations of conservation of mass, momentum, and energy together with the radiative transport equation. The calculations show that although one can construct time-independent models in the supergiant region, these models, however, cannot be physically meaningful since: (1) the solutions for models of outflowing envelopes possess radii of hydrogen burning shell far too small to enable the fitting of these models to the static helium core, (2) the solutions are not self-consistent since the amount of matter to be expelled is too small compared to the amount of matter undergoing acceleration to permit the condition of time-independence to be satisfied. In addition results of model calculations for a 1 $M_{\odot}$ star with luminosity at the surface $L = 4 \times 10^4\ L_{\odot} > L_{crit} = 3.88 \times 10^4\ L_{\odot}$ are also briefly presented with the same conclusions. (auth)

1415 STUDY OF HYDROGEN LINES IN THE ATMOSPHERE OF THE STAR 9 Cep B2 IB. Kuliev, M. R.; Zeinalov, S. K. Tsirk. Shemakh. Astrofiz. Observ.; No. 30-31, 12-14(1973). (In Russian).

Spectrograms were obtained by the Crimean Astrophysical Observatory on a 50" telescope with a dispersion of 14 Å/mm on Kodak OaO film in 1964. Observations were carried out over a period of one month. The line height R_0, the width W_λ and the line width at one-half the line height $\Delta\lambda$ were determined for the star on 1-9-64, 9-9-64 and 15-9-64. Values of R_0, W_λ and $\Delta\lambda$ varied with time. (SJR)

1416 SHOCK WAVES IN GAS STREAMS IN CLOSE BINARY SYSTEMS OF DWARF STARS. Taranov, V. I. (Kaliningrad State Univ., USSR). Astrophysics (Engl. Transl.); 8: No. 4, 332-337(1972).

Translated from Astrofizika; 8: No. 4, 567-575(1972).

A shock wave is formed when a gas stream collides with the envelope around the principal component of the system. It is assumed that energy is lost through radiation behind the shock front. The distribution of the gas-dynamic parameters is found. The thermal instability of the stationary stream behind the shock front is investigated. (auth)

1417 RESONANT DAMPING OF OSCILLATIONS IN A MODEL GLOBULAR CLUSTER. Synakh, V. S.; Fridman, A. M.; Shukhman, I. G. (Novosibirsk State Univ., USSR). Astrophysics (Engl. Transl.); 8: No. 4, 338-343(1972).

Translated from Astrofizika; 8: No. 4, 577-585(1972).

The stability of a spherically symmetric system of masses rotating in circular trajectories is investigated. In agreement with observational data on globular clusters, the density of the system is taken to decrease quadratically with the distance as the edge is approached. It is shown that in such a system: (a) there are no aperiodic perturbations; (b) there are no neutral oscillations; (c) there is resonant damping of oscillations. The absence of complex eigenvalues has been proven previously. (auth)

1418 THEORETICAL EVOLUTION OF HORIZONTAL BRANCH STARS IN GLOBULAR CLUSTERS. Laskarides, P. G. Victoria, B. C.; Univ. of Victoria (1973). vp. National Library of Canada, Ottawa.

Thesis (Ph.D.).

The theoretical evolution of a horizontal-branch star of Population II was followed through the helium-burning in the core phase and was compared with the results by Iben and Rood and by Sweigart and Demarque. As was found by the previous investigators, the evolution through the RR Lyrae gap cannot account for the erratic period variations observed in some of the RR Lyrae variables in the globular clusters. The evolution was repeated with different rates of mass loss during the RR Lyrae phase, and it was found that mass loss rates of 1 to 2×10^{-10} $M_{\odot}$/yr produce period variations of the same order as the observed ones at least for the stars of the moderate metal deficient clusters. An upper limit on the mass loss rate during this phase of evolution of the stars in these clusters was found to be 3×10^{-10} $M_{\odot}$/year. (Diss. Abstr. Int., B)

1419 EVOLUTION OF BINARIES. Harmanec, P.; Kriz, S. (Astronomicky Ustav CSAV, Ondrejov, Czech.). Cesk. Cas. Fys.; 24: No. 5, 469-476(1974). (In Czech).

Present knowledge about the stellar evolution is shortly summarized. Special attention is then devoted to binaries most of which undergo large-scale mass transfer between components during their nuclear life. A new hypothesis is presented according to which hot stars with extended gas envelopes (Be stars)—still considered as single ones—are in fact binaries. It is suggested that mass transfer between components is responsible for the formation of the shell. (auth)

1420 DIAGNOSTIC METHODS IN ASTROPHYSICS. Hekela, J.; Hubeny, I. (Astronomicky Ustav CSAV, Ondrejov, Czech.). Cesk. Cas. Fys.; 24: No. 5, 477-483(1974). (In Czech).

Two basic ways of the spectroscopic diagnostics of the astrophysical plasma are briefly described. In the synthetic approach the problems are illustrated namely on the stellar atmospheres theory. In the analytical approach the methods of solution and the problems of mathematical stability are dealt with especially. (auth)

1421 COLD STARS IN O CLUSTERS. Vardanyan, R. A.; Khachatryan, N. G. (Astrophysical Observatory, Moscow). Astrophysics (Engl. Transl.); 8: No. 4, 362-365(1972).

Translated from Astrofizika; 8: No. 4, 613-619(1972).

It is shown by a statistical method that some of the stars of type M given in the CIT catalog belong to O clusters and O associations, while they do not appear to be associated with B clusters, or only weakly. (auth)

1422 NEUTRINO PAIR EMISSION BY STELLAR: (A) PLASMON–PLASMON, (B) PLASMON–PHONON, AND (C) PHONON–PHONON PROCESSES. Madhyastha, V. L. New York; New York Univ. (1973). 145p. University Microfilms Order No. 74-16,844.

Thesis (Ph. D.).

The "self current" interaction term appearing in the Feynman and Gell-Mann universal V-A theory of weak interaction predicts a first order coupling between plasmons (Γ), phonons (P), and neutrino pairs (ν, $\bar{\nu}$) that leads to plasmon $\rightarrow \nu + \bar{\nu}$ and plasmon + plasmon $\rightarrow \nu + \bar{\nu}$ processes, in addition to several other processes. The pair neutrino energy loss rates were computed for plasmon + plasmon $\rightarrow \nu + \bar{\nu}$, plasmon + phonon $\rightarrow \nu + \bar{\nu}$, and phonon + phonon $\rightarrow \nu + \bar{\nu}$ processes for a degenerate relativistic stellar plasma. In calculating the consequences of the axial vector component of the weak interaction it was assumed that the closed electron loop contributions are those of a vacuum rather than of a plasma. However, in using the vector component of the weak interaction, because of the charge conjugation invariance of the vacuum that leads to a null transition matrix for the triangle loop Feynman diagram, a modified form of the electron propagator appropriate in the plasma medium was employed. The pair neutrino energy loss rates for plasmon + plasmon $\rightarrow \nu + \bar{\nu}$ and plasmon + phonon $\rightarrow \nu + \bar{\nu}$ processes, although significant at $\rho > 10^6$ gm. cm.$^{-3}$ $T \geq 10^{9.5}$K, were found to be several orders of magnitude smaller than that corresponding to plasmon $\rightarrow \nu + \bar{\nu}$. The energy loss rate for the phonon + phonon $\rightarrow \nu + \bar{\nu}$ processes was found to be several orders of magnitude smaller and insensitive to temperature variation compared to those for plasmon + plasmon $\rightarrow \nu + \bar{\nu}$ and plasmon + phonon $\rightarrow \nu + \bar{\nu}$ processes. (Diss. Abstr. Int., B)

1423 HEATING OF YOUNG PLANETARY NEBULAE BY TRAPPED LYMAN-α RADIATION. George, D. (Univ., Leiden). Mon. Notic. Roy. Astron. Soc.; 167: No. 3, 485-491(Jun 1974).

Using a simple model, the effect of trapped Lyman-α radiation on the energy balance of a young planetary nebula with an H I envelope is calculated. It is shown that the Lyman-α heats the gas and that the effect in the H II region is small. However, the heating is so strong in neutral gas that a small neutral globule inside the H II region might not be able to exist in thermal equilibrium at low temperature. In any case, this source of heating could well be important in determining the structure of neutral globules in young planetary nebulae. (auth)

1424 NICKEL OR IRON: THE PROBLEM OF NUCLEOSYNTHESIS AT ATOMIC WEIGHT 56. Hainebach, K. L. Houston, TX; Rice Univ. (1974). 120p. University Microfilms Order No. 74-21,275.

Thesis (Ph. D.).

It is argued that a temperature of 1.8×10^9 K and a time scale of 10^4 years are required to synthesize the β-stable isotope of mass 56, iron, as itself, at neutron enrichment $\eta \simeq .07$, and that such an astrophysical environment does not exist. It is confirmed that ^{56}Fe can be synthesized as ^{56}Ni in supernovae, where stellar material has been heated above 5×10^9 K and consequently the strong nuclear reactions have come into equilibrium. The neutron enrichment of the bulk of the stellar material must be low, $\eta \simeq .005$, a value which is produced by weak interactions during the pre-explosive, hydrostatic burning stages. It is further confirmed that a small amount of neutron-rich material can explain the synthesis of ^{54}Cr and ^{58}Fe. This result has import to γ-ray astronomers for the prospects of observing the nuclear γ-ray lines accompanying the decay of ^{56}Ni to ^{56}Fe. A compilation of nuclear binding energies and spins for both ground and excited states of masses A = 1 to A = 76 and also two-parameter fits for the temperature-dependent nuclear partition functions of those species are contained. (Diss. Abstr. Int., B)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstract 1487.

1425 (AD-776282/6) SCINTILLATION AND APPARENT ANGULAR DIAMETER. Cohen, M. H.; Cronyn, W. M. (Owens Valley Radio Observatory, Pasadena, Calif. (USA)). 1974. Contract N00014-67-A-0094-0019. 18p. NTIS $3.00.

Angular scattering, intensity scintillations, and apparent diameter are discussed in the context of arbitrary irregularity structure. The intrinsic diameter of a source can always be measured with an interferometer in the presence of arbitrarily strong scattering unless all three of the following conditions apply: (1) intrinsic diameter < scattering angle, (2) the source displays weak or no intensity scintillations, (3) a point source shows strong intensity scintillations. If these conditions do apply the apparent diameter is the scattering angle. (auth)

1426 (AD-776283/4) RAPIDLY VARIABLE RADIO SOURCE 3C120. Seielstad, G. A. (Owens Valley Radio Observatory, Pasadena, Calif. (USA)). 1974. Contract N00014-67-A-0094-019. 25p. NTIS $3.00.

Flux density and very long baseline interferometric measurements of 3C120 at several wavelengths and times were analyzed in terms of a model proposed by Ozernoy and Sazonov (1969). Highly satisfactory agreement is achieved if explosive outbursts, each releasing a few times 10^{51} ERG, have occurred approximately every 1.2 years since 1967.0. Each outburst ejects a pair of radio plasmoids in opposite directions at moderately relativistic velocities. The individual components expand, also relativistically, as they travel outward. The rate of component expansion is just sufficient to ensure that inverse Compton losses are negligible. (auth)

1427 (CSIRO-Trans-11333) FLUX DENSITIES OF DISCRETE RADIO SOURCES AT 3.5 CM. II. Gorshkov, A. G.; Spangenberg, E. E.; Valtz, I. E.; Gindilis, L. M.; Konnikova, V. K.; Koptyaev, V. I.; Moiseev, I. G.; Nikitin, V. V.; Soglasnov, V. A.; Soglasnova, V. A. Translated by M. A. Hintze from Astron. Tsirk.; No. 545, 1-3(1970). 3p. Dep. NTIS (US Sales Only) $4.00.

The investigation of discrete radio sources emitting at 3.5 cm wavelength is reported. Tables are given which list source names and peak values of flux density. (auth)

1428 21 CM LINE OBSERVATIONS NEAR THE GALACTIC PLANE IN THE GALACTIC LONGITUDE INTERVAL 339° TO 72°. Lindblad, P. O. (Stockholm Observatory). Astron. Astrophys., Suppl. Ser.; 16: No. 2, 207-236(Aug 1974).

A set of 21-cm line scans with the 300- and 140-foot telescopes at the National Radio Astronomy Observatory in the neighborhood of the galactic plane, containing the general region around the galactic center, are presented in the form of contour maps giving intensity of radiation as a function of velocity and galactic latitude at constant longitude. (1 figure, 37 contour maps) (auth)

1429 X-RAY NOVA FLARES. Amnuel, P. R.; Guseinov, O. H.; Rakhamimov, Sh. Yu. (AN Azerbajdzhanskoj SSR, Baku. Inst. Fiziki). Astrophys. Space Sci.; 29: No. 2, 331-342(Aug 1974).

In order to find out the physical nature of galactic x-ray sources, data on variability of 24 sources during 1964–1971 have been investigated. The fluxes of 9 sources are found to be increasing to the maximum value (for several months) and then slowly decreasing (for ~3 yr). These 9 sources have been related to the class of x-ray novae. The x-ray nova synthetic light curve has been drawn from data on the fluxes of 9 discovered novae. Assumptions have been made on the physical nature of the x-ray novae. Between the flares the x-ray novae may be weak x-ray sources with luminosity about 10^{34} erg s^{-1}. During the flares the luminosity increases to about 10^{38} erg s^{-1}. The number of x-ray sources in the Galaxy is about 10^4 to 10^5, the average distance between them about 0.5 kpc. The object of the optical identification may be a dwarf star of no earlier spectral class than F. (auth)

1430 UPPER LIMITS TO SOFT GAMMA–RAY FLUX FROM SEVEN X–RAY SOURCES AND FROM THE GALACTIC PLANE. Schönfelder, V.; Lichti, G. (Max–Planck–Institut für Physik und Astrophysik, Institut für extraterrestrische Physik, Garching near Munich). Astrophys. J. Lett. 192: No. 1, L1-L2 (15 Aug 1974).

On 1973 February 27, γ–ray measurements in the energy range 1.5–10 MeV were performed with a balloon–borne double Compton–telescope from Palestine, Texas. From these observations, upper limits to the gamma ray flux from seven X–ray sources and from the galactic plane around $l^{II} = 70°$ could be derived. (auth)

1431 ON THE VARIABILITY OF THE COMPACT NONTHERMAL SOURCES. Elliot, J.L.; Shapiro, S.L. (Center for Radiophysics and Space Research, Cornell University). Astrophys. J. Lett. 192: No. 1, L3-L6 (15 Aug 1974).

The shortest time scales of flux variability are plotted against the luminosities for a sample of BL Lac objects, quasars, and Seyfert nuclei. A lower limit to the time scales of variability expected from an accreting black hole is derived. All objects in our sample show time scales equal to or greater than this limit. The expected positions of

supermassive stars and oblique rotators on the time–scale–luminosity diagram are also discussed. (auth)

1432 OBSERVATIONS OF CIRCULAR POLARIZATION OF SCO X-1. Shulov, O. S.; Kopatskaya, E. N. (Leningrad State Univ.). Astrophysics (Engl. Transl.); 8: No. 4, 366-367 (1972).

Translated from Astrofizika; 8: No. 4, 621-624(1972).

Because the existing observational data on the circular polarization of Sco X-1 are sparse and contradictory, a program of further observations was undertaken in the summer of 1972. The results of this program are reported. (WDM)

1433 POSSIBLE ROLE OF SUPERLUMINOUS RADIATION UNDER PULSAR CONDITIONS. Eidman, V. Ya. (Gorky Scientific-Research Radiophysics Inst., USSR). Astrophysics (Engl. Transl.); 8: No. 4, 359-361(1972).

Translated from Astrofizika; 8: No. 4, 609-612(1972).

The possibility that superluminous synchrotron radiation in vacuum is responsible for certain features of pulsar radiation is discussed. (auth)

1434 ANOTHER PULSAR IN THE VICINITY OF A SUPERNOVA REMNANT. Kuchowicz, B. (Univ. of Warsaw). Urania (Krakow); 44: 175-176(1973). (In Polish).

For a long time the nebula IC 443 was suspected to have originated ca. 65,000 years ago in a supernova explosion. Now, a pulsar has been found near that nebula, at a distance of ca. 50 light years from the place where the explosion presumably occurred. This points to a possibility of an ejection of the pulsar with a large momentum. (auth)

1435 PULSARS. Pacini, F. (Cornell Univ., Ithaca, NY). J. Phys. (Paris), Colloq.; No. 7, 35-37(1973).

From centenary congress of the French Physical Society; Vittel, France (28 May 1973).

The neutron star hypothesis is examined for the basic nature of pulsars. (FR)

1436 GAMMA RADIATION FROM THE CRAB NEBULA. Kuchowicz, B. (Univ. of Warsaw). Urania (Krakow); 44: 81-82(1973). (In Polish).

Results of the search for gamma radiation from the Crab Nebula are surveyed. According to a recent recording of the Cherenkov radiation from high energy particles produced in the upper layers of terrestrial atmosphere by incident gamma quanta, the flux of these quanta of an energy above 250 MeV from the direction of the Crab Nebula is ca. $4.4 \cdot 10^{-4}$ quanta per cm^2 per cent. (auth)

1437 REDSHIFTS AND DISTANCES OF QUASARS. Kuchowicz, B. (Univ. of Warsaw). Urania (Krakow); 44: 212-213(1973). (In Polish).

A group of quasars has been selected by Bahcall and Hills according to the criterion that they have the highest luminosity for the given redshift z. All these quasars fit onto a single straight line in the plot of log z vs. apparent luminosity. This points to a cosmological explanation of the quasar phenomenon. (auth)

1438 MAGNETIC FIELD OF PULSARS. Sedrakyan, D. M.; Shakhabasyan, K. M. (Erevan State Univ.). Astrophysics (Engl. Transl.); 8: No. 4, 326-328(1972).

Translated from Astrofizika; 8: No. 4, 557-560(1972).

Two mechanisms of generation of a magnetic moment of pulsars were considered. It is shown that if the proton fluid is assumed superconducting and the electron fluid normal, a magnetic moment arises as a result of rotation and it is parallel to the axis of rotation. Estimates for the pulsar in the Crab Nebula give $M = 10^{32}$ $G \cdot cm^3$. (auth)

1439 PULSARS IN SUPERNOVA REMNANTS. Amnuel, P. R.; Guseinov, O. Kh.; Kasumov, F. K. (Shemakha Astrophysical Observatory, Baku). Astrophysics (Engl. Transl.); 8: No. 4, 329-331(1972).

Translated from Astrofizika; 8: No. 4, 561-566(1972).

A study was made of the radio and x-ray spectra of six supernova remnants. The data on the characteristic break in the spectra indicate that there may be a pulsar (neutron star) in the remnant of SN Tycho (besides the known remnants containing pulsars: Crab and Vela X). There is apparently no active source in the remnants of Cas A, Pup A, and Cyg Loop. (auth)

1440 ABSORPTION-LINE SPECTRUM OF THE QUASI-STELLAR OBJECT PHL 957. Wingert, D. W. Princeton, NJ; Princeton Univ. (1974). 58p. University Microfilms Order No. 74-17,501.

Thesis (Ph. D.).

Six new high-dispersion spectra of the quasi-stellar object PHL 957 ($z_{em} = 2.69$) were obtained with the Princeton integrating television system at the coudé focus of the 200-inch telescope. Together with earlier data, 179 absorption lines were found, mostly between 3550 and 4500 Å. The absorption redshift system at z = 2.3099 was most prominent with 26 lines, including a very strong Lyman-alpha line. Another system, close to the emission redshift, was found to be double with z = 2.6638 and 2.6624. Many lines were identified as $L\alpha - L\beta$ pairs. For the major redshift systems and the $L\alpha - L\beta$ pairs, column densities and velocity dispersions were calculated using curves of growth. The redshift system at z = 2.3099 resembles interstellar material in ionization and abundance ratios, and constitutes strong evidence for absorption originating in a galaxy along the line of sight to the quasar. The double system at z = 2.663 has higher ion states and most likely is associated with the quasar. (Diss. Abstr. Int., B)

1441 INTERPRETATION OF CONTINUUM FLUX OBSERVATIONS FROM THERMAL RADIO SOURCES. I. Continuum Spectra and Brightness Contours. Salem, M.; Seaton, M. J. (University Coll., London). Mon. Notic. Roy. Astron. Soc.; 167: No. 3, 493-510(Jun 1974).

From maps of the brightness temperatures T_b of a thermal radio source, at frequency ν_0 angular areas are obtained enclosed by contours, $\omega(T_b(\nu_0))$; this function is such that $T_b \geq T_b'$ within the area $\omega(T_b')$. The spectrum of the total flux density, S_ν, observed at many frequencies ν, may be fitted to an analytic function of a frequency variable $x = f(\nu)$. It is shown that, using an inverse Laplace transform, $T_e\Omega(E)$ is obtained as a function of $v = E/T_e^2$, where T_e is the electron temperature, E is the emission measure, and $\Omega(E)$ is such that $E \geq E'$ within the angular area $\Omega(E')$. Assuming a value for T_e, $\Omega(T_b(\nu_0))$ may be deduced from the spectrum observations. Adjustment of T_e can be made so as to obtain a best fit to $\omega(T_b(\nu_0))$ deduced from observations with high angular resolution. If significant structural detail has not been resolved, the results obtained for T_e will tend to be too small. Information concerning the extent to which structural detail is resolved can be deduced if an independent estimate of T_e is available. For the Orion nebula, line observations at optical and radio wavelengths indicate that $T_e = 9000 \pm 1000$ K. It is shown that the radio continuum data is consistent with this result, but that full resolution of structural detail has not been achieved in some of the published work on brightness contours. For the compact H^+ region DR21 the best fit is obtained with $T_e = 8000$ K, in agreement with the work of Harris (Mon. Not. R. Astr. Soc.; 162: 5P(1973)), but the available data does not exclude a higher value of T_e, say $T_e = 9000$ K. Various sources of error in the processes of observation and analysis are discussed. (auth)

1442 INTERPRETATION OF CONTINUUM FLUX OBSERVATIONS FROM THERMAL RADIO SOURCES. II. Three-Dimensional Models. Salem, M. (University Coll., London). Mon. Notic. Roy. Astron. Soc.; 167: No. 3, 511-515(Jun 1974).

Given a function $\Omega(E)$, which is the total angular area containing matter with emission measure $\geq E$, a unique model of a thermal radio source may be constructed for a given geometry. The construction of a spherical model with filling factor unity is described. Such a model is constructed for the Orion nebula, and compared with a model computed by a different method. The significance of models of this type is briefly discussed. (auth)

Solar Phenomena

Refer also to abstracts 1373, 1541, and 1547.

1443 (AD-779434) FINE STRUCTURE OF THE SOLAR CHROMOSPHERE. Interim report, 1 February–30 September 1973. Bhavilai, R. (Chulalongkorn Univ., Bangkok (Thailand)). 30 Nov 1973. 24p. NTIS $3.00.

The solar limb has been studied visually and photographically in the light of H α and the combined results are reported. The appearance of a spicule changes with wavelength settings. Effects due to changes of spicule velocities with height and opacity-wavelength relations are indicated. A number of bright spicules seen in the wings are identified with bright mottles seen in the line core. The dark band appears between $\delta\lambda = \pm 1.0$A and $\delta\lambda = \pm 0.70$A. Examination of a small mottle cluster in a series of photographs taken in steps from H α + 0.85A to H α + 0.10A leads to a three-dimensional model of a typical mottle cluster. (auth)

1444 (AD-779682) SOLAR PROTON OBSERVATIONS AT THE SYNCHRONOUS ALTITUDE DURING THE CINOF TIME PERIOD. Blake, J. B.; Paulikas, G. A. (Aerospace Corp., El Segundo, Calif. (USA)). 6 May 1974. Contract F04701-73-C-0074. 17p. (SAMSO-TR-74-114). NTIS $3.00.

Data were acquired during the Cinof time period of 5–29 June 1972 with the Aerospace Corporation omnidirectional spectrometer

aboard the synchronous altitude spacecraft ATS-1 (1966–110A). During the Cinof time period, the ATS-1 instrument countrate was substantially above background during 8–10 June and 16–20 June. A proton intensity increase was observed at 1312 UT on 17 June resulting from a sudden commencement. At three other times, substantial proton enhancements were observed, presumably due to a change in the interplanetary particle and field configuration. (auth)

1445 (KHFTI-73-10, pp 28-30) POSSIBLE EXISTENCE OF NEW LEVELS IN NUCLEI WITH A = 6 AND EXPERIMENTS WITH SOLAR NEUTRINOS. Kopysov, Yu. S. (Inst. of Nuclear Research, Moscow); Fetisov, V. N. 1973. (In Russian).

One of the possible explanations for the discrepancy of the experimental results on the registration of the neutrino current from the sun with the predictions of the evolution theory of the sun—the effect of resonance in the $^3He + ^3He$ system—was examined. For a profound understanding of the nuclear physical processes on the sun the search for an accurate location of the 1^+ and 0^+ levels with isospin T = 0 and T = 1 in ^6Li in the region E ≈ 10 to 16 MeV is of importance. It is suggested that these levels might be detectable in the inelastic scattering reaction of electrons which can occur in the monopole excitation of α clusters in ^6Li. (INIS)

1446 DIURNAL AND ANNUAL COURSE OF THE RADIATION BALANCE. Lingova, S. Izv. Inst. Khidrol. Meteorol., Bulg. Akad. Nauk.; 19: 85-112(1972).

The regularities in the diurnal and annual course of the radiation balance were investigated, under average conditions of cloudiness, cloudless sky-cloudiness ≥ 2 and an open disk cloudy sky-cloudiness ≥ 8, with an uncovered and covered disk of the sun. By means of the mean-square deviation and the mean deviation, the changes in the moment hourly values of the radiation balance were investigated. It was established that the amplitude of the diurnal changes in the radiation balance has a clearly expressed annual course which increases from winter to summer, after which it decreases. Owing to the peculiarities in the diurnal course of the effective radiation and the total radiation, an asymmetry is observed in the diurnal course of the radiation balance. A correlation coefficient is obtained, between the moment values of the radiation balance and the temperature gradient (temperature on the surfaces of the ground and above 2 meters). The relation between the hourly sums of the radiation balance B and the balance of short-wave radiation Bk is expressed by means of the following regressive equations: B = 0.88 Bk−4.81—at cloudless sky, B = 0.88 Bk−1.78—at covered sky, B = 0.88 Bk−3.43—at actual conditions of cloudiness. (Abstr. Bulg. Sci. Lit., Math., Phys., Astron., Geophys., Geod.)

1447 ON THE ASYMMETRY OF SELECTED FRAUNHOFER LINES, II. Kostik, R. I.; Orlova, T. V. (AN Ukrainskoj SSR, Kiev). Solar Phys.; 36: No. 2, 279-285(Jun 1974).

The asymmetry of 11 absorption lines of neutral iron was determined from observations made with the double-pass system on the horizontal solar telescope ASU-5. An attempt was made to interpret this asymmetry in terms of progressive sound waves. The value of asymmetry computer theoretically was shown to be on average only 20% of the observed value. (auth)

1448 SUB- AND SUPERHYDROSTATIC EQUILIBRIUM IN SUNSPOTS. Research Note. Mattig, W. (Fraunhofer Institut, Freiberg 1.Br., F. R. Germany). Solar Phys.; 36: No. 2, 275-277 (Jun 1974).

Spectra of umbrae close to the limb, taken with the domeless Coude refractor in Anacapri in 1969 have been analyzed. The observations clearly show that the majority of sunspot umbrae approximately are in hydrostatic equilibrium, but that gross deviations from this behavior may occur in both directions. (auth)

1449 THE NATURE OF THE SUNSPOT PHENOMENON. I. Solutions of the Heat Transport Equation. Parker, E. N. (Chicago Univ., Ill. (USA). Dept. of Physics). Solar Phys.; 36: No. 2, 249-274(Jun 1974).

Heat transport in the Sun is describable by a Fokker–Planck, or diffusion, transfer equation. A study of the general character of the solutions of the transfer equation shows that the inhibition of convective transport beneath the photosphere produces a photospheric dark ring surrounded by a bright ring, or at best, a dark area surrounded by a bright ring. The mean temperature beneath the "sunspot" is unavoidably above normal, so that the enhanced gas pressure would disperse, rather than concentrate, the magnetic field. Hence it is concluded that the inhibition of convection cannot be the cause of a sunspot. It is suggested, instead, that a sunspot is a region of enhanced, rather than inhibited, energy transport and emissivity. The magnetic field of the sunspot causes a dynamical overstability in the outer thousand km of the convective zone, generating copious fluxes of hydromagnetic waves, which propagate rapidly out of the region along the magnetic field. It is suggested that this heat engine is so efficient as to convert at least three-fourths of the heat flux into waves. Solutions of the heat transport equation in the presence of a heat sink automatically resemble the observed sunspot, including a dark interior, a sharp transition at the edge of the umbra, and an extended grey area around the outside, the penumbra. The mean temperature is reduced, causing the observed concentration of the magnetic field. The enhanced radiation is in the form of hydromagnetic waves, which do not appear in ordinary photographs, but which light up the "sky" over the sunspot in a manner conspicuous in any uv or x-ray picture. In this respect, then, a sunspot is effectively a hole in the Sun, extending down to temperatures of 2×10^4K or more. (auth)

1450 THE RESPONSE OF AN ISOTHERMAL ATMOSPHERE TO PRESSURE FLUCTUATIONS AT ITS BASE AND THE FIVE-MINUTE OSCILLATIONS IN THE SOLAR PHOTOSPHERE. Moore, R. L. (Hale Observatories, Pasadena, Calif. (USA)). Solar Phys.; 36: No. 2, 321-337(Jun 1974).

The steady-state vertical-velocity response of an isothermal atmosphere to pressure fluctuations of arbitrary period and horizontal wavelength at its base is derived in the approximation of dissipationless polytropic motion in the atmosphere. It is pointed out that, since only upward modes can be excited in an isothermal atmosphere perturbed from below, the infinite response found by Worrall (1972) at the critical frequency ωg does not occur. The correct behavior of the response is presented in some detail. Comparison of the response of the model, for the case of isothermal oscillations, with observed features of the photospheric oscillations indicates that, in addition to the evanescent photospheric oscillations which occur at the compression-wave propagation cut-off frequencies and which have horizontal wavelengths ≳3000 km, in the lower photosphere there are also smaller-scale evanescent oscillations which have horizontal wavelengths ≲1000 km, periods ranging from 200 to 400 s, amplitudes comparable to that of the larger-scale oscillations and in which the phase of the vertical velocity oscillation leads the phase of the pressure oscillation. (auth)

1451 THE ORIGIN OF THE SOLAR FIVE-MINUTE OSCILLATION. Musman, S. (Sacramento Peak Observatory, Air Force Cambridge Research Labs., Sunspot, N. M., USA). Solar Phys.; 36: No. 2, 313-319(Jun 1974).

Two absorption lines formed in the lower photosphere were used to study simultaneous velocity and intensity fluctuations. No significant correspondence was found between the locations of granules and those of oscillation, even when a time lag was included. This result supports the explanation of the origin of the oscillations as a self-excited sound wave rather than the local response to a granule excitation. (auth)

1452 ATOMIC-BEAM STUDY OF THE 5-MIN SOLAR WAVELENGTH OSCILLATIONS. Snider, J. L.; Eisenstein, J. P.; Otten, G. R. (Oberlin Coll., Ohio (USA)). Solar Phys.; 36: No. 2, 303-312(Jun 1974).

Long records of the wavelength oscillations of the solar 7699 Å potassium line have been obtained with an atomic-beam resonance-scattering apparatus taken to Kitt Peak. Data are presented giving the dependence of rms oscillation amplitude on the size of the area observed and power spectra of the oscillations are shown. The results are compared with recent work by others. (auth)

1453 ON THE ENERGY DISTRIBUTION IN WAVENUMBER SPECTRA OF THE GRANULAR VELOCITY FIELD. Deubner, F. L. (Fraunhofer Institut, Freiburg, F. R. Germany). Solar Phys.; 36: No. 2, 299-301(Jun 1974).

Wavenumber spectra of spatial velocity fluctuations measured in selected high resolution solar photospheric spectrograms are presented. The statistical stability of the power estimates of particular "peaks" in these spectra is discussed. (auth)

1454 ONE- AND MULTI-COMPONENT MODELS OF THE UPPER PHOTOSPHERE BASED ON MOLECULAR SPECTRA. III. CH(0,0) λ3144 of the CH C-X System. Mount, G. H.; Linsky, J. L. (National Bureau of Standards, Boulder, Colo. (USA)). Solar Phys.; 36: No. 2, 287-298(Jun 1974).

Accurate center-to-limb photoelectric spectra of CH (0,0) C-X bandhead region λ3143 to 3148 Å have been obtained at Kitt Peak National Observatory. From these spectra and a detailed analysis of the formation of the CH(0,0) spectrum it is demonstrated that the best-fit upper photospheric model derived from previous analyses of CN(0,0) and CN(1,1) spectra adequately explains the CH C-X observations. In addition a solar carbon abundance of $\log A_C = 8.30 \pm 0.20$ is derived compared to the HSRA value of $\log A_C = 8.55$. This confirms previous CN analyses which demonstrated that if the HSRA nitrogen abundance of $\log A_N = 7.93 \pm 0.10$ is assumed, then $\log A_C = 8.20 \pm 0.10$. The regions of formation for the CH(0,0) λ3143. 47 Å band-head at disc center and limb are also specified. (auth)

1455 THE Fe XIV BRIGHTNESS MEASUREMENTS: 30 JUNE 1973. Fisher, R. R. (Sacramento Peak Observatory, Air Force Cambridge Research Labs., Sunspot, N. M., USA). Solar Phys.; 36: No. 2, 343-344(Jun 1974).

Observations of the monochromatic corona were obtained outside of eclipse with the Sacramento Peak Observatory λ5305 photoelectric coronal photometer on June 30, 1973. With this instrument, the Fe XIV line is isolated by a birefringent filter with a 0.58 Å full width at half maximum; the 40 cm coronograph is used to produce a 100 mm solar image. Results showing the intensity of the λ5303 line plotted as a function of position angle and height above the limb are presented. (auth)

1456 CORONAGRAPHIC OBSERVATIONS BEFORE AND AFTER THE ECLIPSES OF 10 JULY 1972 AND 30 JUNE 1973. Research Note. Poulain, P. (Observatoire du Pic du Midi, 65-Bagneres-de-Bigorre (France)). Solar Phys.; 36: No. 2, 339-342(Jun 1974). (In French).

The results of coronagraphic observations made at Pic-du-Midi Observatory, on the occasion of the total solar eclipses of July 10th, 1972 and June 30th, 1973 are presented. It is thought that these measurements can be useful for comparison with data from eclipse expeditions. (auth)

1457 SPECTROGRAPH, FILTERGRAPH AND MAGNETOGRAPH OBSERVATIONS OF THE TWO-RIBBON FLARE OF 29 JULY 1973. Michalitsanos, A. G.; Kupferman, P. (Hale Observatories, Pasadena, Calif. (USA)). Solar Phys.; 36: No. 2, 403-416(Jun 1974).

High-resolution detailed observations are presented of the class 3N two-ribbon flare of 1973, July 29 (McMath 12461), which was associated with the disappearance of a large filament ("disparition brusque"). This flare occurred in a diffuse bipolar magnetic region completely devoid of sunspots, and was further associated with a type IV radio burst and a soft x-ray event. Extensive Hα filtergraph, spectrograph, and magnetograph records during the main phase of the flare suggest that downfalling and streaming material is present on both ribbons for several hours during the Hα emission enhancement, but only at a small number of points located both on and off the ribbons. A poor spatial correspondence is found between bright emission knots in the Hα ribbons and the positions of the observed downward motion. It is concluded that the model of infall-impact of Hyder (1967) is not consistent with the filtergraph and spectrograph observations. (auth)

1458 IONIZATION EQUILIBRIUM IN SOFT X-RAY-EMITTING SOLAR FLARES. Phillips, K. J. H.; Neupert, W. M.; Thomas, R. J. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Solar Phys.; 36: No. 2, 383-401(Jun 1974).

Studies of the flare-produced line feature at 1.9 Å due to highly ionized iron show that it is emitted in conditions closely approximating steady-state ionization equilibrium. Calculations of the line flux per unit emission measure from time-dependent and steady-state ionization equilibria are compared with observed values during four flares in particular. Only for electron densities $N_e \gtrsim 10^{10}$ cm^{-3} do the time-dependent equilibrium values give as good an approximation to the observed values as the steady-state equilibrium. This lower limit is compared with values of N_e derived from analyses of the temperature decline in each of these events, and with estimates of N_e given by other workers. (auth)

1459 THE SLOWLY VARYING COMPONENT OF SOLAR METER WAVELENGTH RADIATION: A NON-THERMAL RADIO SOURCE. Riddle, A. C. (Colorado Univ., Boulder (USA). Dept. of Astro-Geophysics). Solar Phys.; 36: No. 2, 375-381(Jun 1974).

The slowly varying component of solar centimeter wavelength radiation can often be attributed to thermal emission from density enhancements above an active region. This assertion is justified by the success in reproducing the observations by ray tracing calculations in appropriate coronal models. Similar components have been observed at meter wavelengths and thermal radiation from density enhancements has again been suggested as the emission mechanism. However ray tracing calculations at meter wavelengths, unlike those at centimeter wavelengths, must include both refraction and scattering effects for realistic modelling. In this study, in which scattering is included for the first time, it is shown that scattering may lead to lower emission from density enhancements rather than higher emission as predicted by models in which refraction alone is considered. This strongly suggests that the emission observed at meter wavelengths is of nonthermal origin. (auth)

1460 COMMENTS ON THE ROLE OF CONDUCTION IN OPTICAL FLARE HEATING. Brown, J. C. (Space Research Lab., Astronomical Institute, Utrecht, The Netherlands). Solar Phys.; 36: No. 2, 371-374(Jun 1974).

Recent papers by Shmeleva and Syrovatskii (1973) and by Svestka (1973) have proposed that the chromospheric optical flare may be a secondary phenomenon fed with energy by conduction from the high temperature coronal flare plasma, which they regard as the primary event (cf. also Takakura, 1973). In this note, attention is drawn to some consequences of, and discrepancies in, these proposals. (auth)

1461 1.0 ARC SECOND STRUCTURE OF THE SUN AT 3.71 CM WAVELENGTH. Hobbs, R. W.; Jordan, S. D.; Webster, W. J. Jr.; Maran, S. P.; Caulk, H. M. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Solar Phys.; 36: No. 2, 369-370 (Jun 1974).

Recently the authors reported the existence of small scale (2.8″) structure in solar active regions at 3.71 and 11.1 cm. They have now confirmed the existence of even smaller scale structures in active regions with sizes less than 1″ (700 km) at 3.71 cm wavelength. (auth)

1462 HIGH RESOLUTION INTERFEROMETRY OF THE SUN AT 3.7 CM WAVELENGTH. Lang, K. R. (California Inst. of Tech., Pasadena (USA). Dept. of Physics). Solar Phys.; 36: No. 2, 351-367(Jun 1974).

Interferometric observations of the Sun at a wavelength λ = 3.7 cm and an effective angular resolution of Θ = 7 or 15″ are presented. When active regions are observed, circularly polarized radiation is found with an angular size of $\Theta \sim 15''$, an effective temperature of $T \sim 5 \times 10^5$K, and 20 to 30% circular polarization. This S-component of solar radio radiation is interpreted in terms of the theory of gyroradiation and gyroresonant absorption. Prior to the onset of a solar flare, an additional S-component is observed with an angular size of $\Theta \lesssim 7''$, an effective temperature of $T \geq 10^6$K, and 90 ± 10% circular polarization. A small scale, quasi-periodic component of solar radio radiation is also observed to be coming from all over the solar disk; and this component is found to be less than 10% circularly polarized. The angular sizes, θ, and periods, p, of this component lie in the ranges $7'' \lesssim \theta \lesssim 37''$ and 180s $\lesssim P \lesssim$ 750s. The observed modulation in flux density, ΔS, lies in the range 20f.u. $\lesssim \Delta S \lesssim$ 200 f.u. (1f.u. = $10^{-26}Wm^{-2}Hz^{-1}$ or $10^{-23}ergs^{-1}cm^{-2}Hz^{-1}$) and the brightness temperature fluctuations, ΔT, lie in the range $10^3K \lesssim \Delta T \lesssim 10^5K$. This component of solar radio radiation is thought to be the free-free radiation (bremsstrahlung) of temperature fluctuations associated with velocity oscillations in the chromosphere–corona transition region. High-resolution observations of impulsive microwave bursts show that some of the radiation is linearly or circularly polarized, has an angular size $\theta \lesssim 7''$, and a peak brightness temperature of $T \gtrsim 3 \times 10^6$K. This component of solar radio flares is interpreted in terms of the theory of gyro-synchrotron radiation, and the density of accelerated electrons is found to be greater than 100 cm^{-3}. The size of the emitting region is, however, comparable to that of the feet of magnetic dipoles rather than the region between them. Phase shifts in the interferometer pattern observed during an impulsive burst are interpreted in terms of hydrodynamic waves travelling at a velocity of 7000 kms^{-1}, but further observations are needed to confirm the result. (auth)

1463 REPRESENTATIONS OF CORONAL MAGNETIC FIELDS INCLUDING CURRENTS. Levine, R. H.; Altschuler, M. D. (National Center for Atmospheric Research, Boulder, Colo. (USA)). Solar Phys.; 36: No. 2, 345-350(Jun 1974).

Coronal electric currents are superposed on the calculated large-scale current-free (potential) magnetic field of the solar corona and the new magnetic configurations are mapped. The results indicate that relatively large coronal electric currents are required before significant topological deviations from the potential magnetic field configuration can be noticed. Thus any agreement between coronal observations and calculated potential magnetic field configurations should not be interpreted to mean that coronal electric currents are necessarily absent or insignificant. (auth)

1464 A CLUE TO THE TRIGGER FOR BOTH THE TYPE III SOLAR RADIOBURST AND THE SOLAR FLARE. Priest, E. R. (Saint Andrews Univ. (UK)); Heyvaerts, J. (Observatoire de Paris, Section de Meudon, 92 (France)). Solar Phys.; 36: No. 2, 433-442(Jun 1974).

Recent observations of "neutral line absorbing features" in the solar atmosphere may give an important clue to the mechanism whereby both Type III solar radio-bursts and solar flares are triggered. It is suggested that as new satellite magnetic flux emerges at the edge of an active region in an area of opposite polarity a neutral sheet builds up between the new and old flux. When the sheet has a length of about a megametre its thermal insulation from the surrounding plasma is effective enough for a thermal instability to occur. The resulting compression

and inflow of plasma is observed in Hα on the disc as a neutral line absorbing feature. Furthermore, the electric field of the accompanying collisionless tearing mode instability in a thin slab near the center of the sheet exceeds the runaway field; it may therefore accelerate electrons to high enough energies to produce the Type III burst which usually occurs at the same time as the absorbing feature. Perhaps the flare which sometimes ensues is triggered when the quasi-equilibrium state is destroyed by the development of turbulence in the neutral sheet. (auth)

1465 TYPE II RADIO BURSTS AND PARTICLE ACCELERATION. Svestka, Z.; Fritzova-Svestkova, L. (Fraunhofer Institute, Freiburg, F. R. Germany). Solar Phys.; 36: No. 2, 417-431 (Jun 1974).

328 particle events recorded during 30 months from January 1, 1966 to June 30, 1968 (taken from the new Catalog of Solar Particle Events, 1955-1969) are compared with the occurrence of 166 Type II radio bursts during the same period. The results of this comparison give a convincing evidence that proton acceleration to higher energies in flares (the "second acceleration step") is closely connected with the Type II burst occurrence. The shock wave appears to originate near the time when the impulsive burst occurs, and the second acceleration step follows immediately the first one; in some cases the second step sets in while the first step is still in progress. A detailed analysis indicates that one may need even three different acceleration mechanisms in flares: the first one gives rise to electrons which produce the microwave and hard x-ray bursts (and it probably also accelerates protons to low energies); the second, which sometimes coincides (but mostly does not coincide) with the first one, produces beams of electrons which give rise to Type III bursts; and the third one, characterized by the Type II burst-producing shock wave, accelerates (on some, rather rare occasions) the particles, preaccelerated by the first mechanism, to higher energies. (auth)

1466 ON THE THIRD HARMONIC IN SOLAR RADIO BURSTS. Zheleznyakov, V. V.; Zlotnik, E. Ya. (Gor'kovskij Gosudarstvennyj Univ. (USSR). Radiofizicheskij Inst.). Solar Phys.; 36: No. 2, 443-449(Jun 1974).

Possible mechanisms of the third harmonic generation in solar radio bursts are investigated. It is shown that the most essential is the coupling of plasma waves in a source with electromagnetic radiation at the second harmonic. This phenomenon may be responsible for the occurrence of the third harmonic in the Type V event on 25 October 1972 recorded by Benz, as well as in the U-burst on 3 September 1957 reported by Haddock and Takakura. (auth)

1467 THE THIRD HARMONIC OF TYPE III SOLAR RADIO BURSTS. Takakura, T.; Yousef, S. (Commonwealth Scientific and Industrial Research Organization, Epping (Australia). Div. of Radiophysics). Solar Phys.; 36: No. 2, 451-458(Jun 1974).

Two examples of pairs of "J-shaped" Type III bursts with 2:3 frequency ratio are given. It is suggested that these could be the second and the third harmonics of undetected fundamental radiation. The 80 MHz heliograph source of the third harmonic showed an apparent brightness temperature of $10^{9.6}$K, while the order of 10^{10}K seems to be required theoretically. This may imply that the apparent radio source was composed of many unresolved small sources of much higher brightness temperature. (auth)

1468 A MULTITHERMAL ANALYSIS OF SOLAR X-RAY EMISSION. Dere, K. P.; Horan, D. M.; Kreplin, R. W. (Naval Research Lab., Washington, D. C. (USA)). Solar Phys.; 36: No. 2, 459-472(Jun 1974).

The NRL SOLRAD 10 satellite carries six ionization chambers to measure solar x radiation in the 0.5 to 60 Å wavelength band. The x-ray emission spectrum in this range is determined by the derivative of the coronal emission measure ($\int N_e^2 dV$) with respect to temperature when the thermal processes of bremsstrahlung, radiative recombination, and line radiation are considered. If a simple model for this differential emission measure is used and detector responses to the calculated spectra are fitted to the SOLRAD data by a least squares method, the differential emission measure can be obtained for temperatures between 2×10^6K and 64×10^6K. Data during quiet and flaring periods are analyzed and the general behavior of the differential emission measure during flares is presented. This analysis is based on experimental measurements of the efficiencies of the SOLRAD detectors. (auth)

1469 PROPAGATION OF FLARE PROTONS IN THE SOLAR ATMOSPHERE. Reinhard, R.; Wibberenz, G. (Kiel Univ. (F. R. Germany). Inst. fuer Reine und Angewandte Kernphysik). Solar Phys.; 36: No. 2, 473-494(Jun 1974).

The velocity dispersion for a large number of solar proton events is analyzed in the energy regime of 10 to 60 MeV. It is found for all events that the time from the flare to particle maximum, tm, is well represented by a sum of two components. The first component which is energy independent describes the propagation in the solar atmosphere, the second component describes the propagation in the interplanetary medium giving a velocity dispersion $\nu \times tm = const$. The additional study of time intensity profiles, onset times, and multispace-probe observations reveals that the propagation in the solar atmosphere consists of three processes: (1) a rapid transport process in the initial ($\lesssim 1$ h) phase after the event fills up a "fast propagation region (FPR)", which may extend up to $\sim 60°$ from the flare site and which is tentatively identified with a large unipolar magnetic cell as seen on Hα synoptic charts, (2) a large-scale drift process which is energy independent with drift velocities νD in the range $1° < \nu D < 4°h^{-1}$, and simultaneously (3) a diffusion process which yields the general broadening of the intensity time profiles for eastern hemisphere events, which is, however, of less importance than previously assumed. (auth)

1470 DIFFERENTIAL ROTATION AND SECTOR STRUCTURE OF SOLAR MAGNETIC FIELDS. Stenflo, J. O. (Lund Observatory, Lund, Sweden). Solar Phys.; 36: No. 2, 495-515 (Jun 1974).

The differential rotation and sector structure of solar magnetic fields has been studied using digitized data on photospheric magnetic fields recorded at the Mount Wilson Observatory during the period August 1959-May 1970. The power spectra show considerable power in high-frequency peaks, corresponding to harmonic components with wavelengths less than $1/10$ solar rotation. Calculations for a series of shorter time intervals show how the distribution of power over the various harmonic components in the sector pattern varies strongly with the solar cycle. The equatorial rotation rate of solar magnetic fields is about 0.1 km s^{-1} faster than that of the photospheric plasma determined from Doppler shifts. It is shown that the Doppler measurements mainly refer to the non-network regions. The differential flow of 0.1 km s^{-1} forms streamlines around the magnetic fine structures. The different rotation rates of various solar features can be explained in terms of the rotation rates of magnetic and non-magnetic regions. The rotation rates of the magnetic fields in active and quiet regions agree at the equator. At higher latitudes, however, the background fields deviate less from solid-body rotation, indicating that their source is below the deepest layers to which the sunspot magnetic fields penetrate. This suggests that turbulent diffusion of the field in old active regions may not be the main source for the background magnetic field, but that the source is located close to a rigidly rotating solar core with a synodic rotation period of 26.87 days. (auth)

1471 RADIOASTRONOMY ON DECAMETER WAVELENGTHS AT MEUDON AND NANCAY OBSERVATORIES. Report from Solar Institute. Boischot, A. (Observatoire de Paris, Section de Meudon, 92 (France)). Solar Phys.; 36: No. 2, 517-522(Jun 1974).

Since 1969, several instruments have been designed and built at Nancay to perform research on solar and planetary radioemissions in the range of decameter wavelengths. Emphasis has been set upon the high-resolution spectrography of the radiobursts, both in time and frequency. The present note describes the instruments which were operational at the end of 1973, and gives a brief survey of the main topics which have been studied up to now. (auth)

1472 ABRUPT DEPLETIONS OF THE INNER CORONA. Hansen, R. T. (High Altitude Observatory, Boulder, CO); Garcia, C. J.; Hansen, S. F.; Yasukawa, E. Publ. Astron. Soc. Pac.; 86: No. 512, 500-515(Aug 1974).

During the time period 1970-early 1973, 13 instances of major abrupt depletions of localized regions of the inner solar corona (1.1 to 2 $R_\odot$) were detected at Mauna Loa, Hawaii. Because of their almost invariable association with the ascending Hα prominence material (most generally flare sprays and, in one instance the disparition brusque of a large filament near the solar limb) and close correlation in time and position with outward moving Type IV radio sources, it is surmised that the coronal material was expelled from the Sun. In several of these cases plasma clouds were tracked to 10 $R_\odot$ by Naval Research Laboratory with a coronagraph aboard OSO-7. Limited evidence suggests that some aspects of a coronal disturbance, including trajectory of flare spray and depletion of the inner corona, are homologous within 24 hours, so the overall coronal magnetic field configuration is not necessarily permanently altered. (auth)

1473 THEORY OF THE POLARIZATION OF CORONAL FORBIDDEN LINES. House, L. L. (High Altitude Observatory, Boulder, CO). Publ. Astron. Soc. Pac.; 86: No. 512, 490-499(Aug 1974).

A brief review, presented in simplified terms, is given for the theory of the origin of coronal emission-line polarization. A classical view of the scattering problem in terms of harmonic oscillators is first presented where the influence of the magnetic field is demonstrated. The Van Vleck depolarization phenomena is described in these terms. Next, a more precise physical picture of the emission-line polarization is established through a discussion of the Zeeman effect in scattering. Sample results are discussed for three-dimensional coronal emission-line models based upon the solution of the statistical equilibrium equations for magnetic sublevels of the Fe XIV ion. Finally, comments are directed toward the determination of magnetic fields based upon emission-line polarization observations where both modeling and deconvolution procedures are mentioned. (auth)

1474 SOLAR RADIATIONS AND THE EARTH. Proceedings of the Symposium Held at Delhi, India, June 21–26, 1971. Tandon, J. N. (ed.). Portland, OR; International Scholarly Book Services, Inc. (1973). 350p. (CONF-710673-). $14.00.

Topics covered at this meeting included electromagnetic radiations from solar flares, solar wind, solar corpuscular radiations, and their interaction with the Earth. The research papers are supplemented with review articles. (WDM)

1475 EXPANSION OF A LOW-DENSITY SOLAR CORONA: A ONE-FLUID MODEL WITH MAGNETICALLY MODIFIED THERMAL CONDUCTIVITY. Durney, B. R. (National Center for Atmospheric Research, Boulder, CO); Hundhausen, A. J. J. Geophys. Res.; 79: No. 25, 3711-3716(1 Sep 1974).

A one-fluid model of the coronal expansion, including the reduction in radial heat conduction produced by a spiral interplanetary magnetic field, is extended to the low coronal densities that may occur in the regions of open diverging magnetic field lines, or "coronal holes," that are regarded as probable sources of the solar wind. At such densities, the "cutoff" in heat conduction at very large heliocentric distances (where the magnetic field becomes nearly azimuthal) has a profound effect on the nature of the expansion. The corona becomes nearly isothermal out to the distance where the flow of plasma dominates the transport of energy. This outward extension of high coronal temperatures leads to large solar wind speeds, approaching those given by Parker's original isothermal model as the coronal density becomes vanishingly small. The model predicts expansion speeds as high as 500 km s^{-1}, with densities in agreement with those observed near the orbit of earth, for a reasonable set of coronal densities and temperatures (e.g., with coronal temperatures no higher than 2.1×10^{6}°K). However, the temperatures (or pressures) predicted at the orbit of earth are substantially higher than those observed; this deficiency of the model could only be removed by incorporation of additional physical effects or processes. (auth)

1476 SOLAR CORONAL HOLES AS SOURCES OF RECURRENT GEOMAGNETIC DISTURBANCES. Neupert, W. M. (Goddard Space Flight Center, Greenbelt, MD); Pizzo, V. J. Geophys. Res.; 79: No. 25, 3701-3709(1 Sep 1974).

Observations of the solar corona by Oso 7 were used in a superposed epoch analysis to study the relations between classes of coronal features and geomagnetic activity. Both bright coronal regions (associated with solar activity) and regions of less than average brightness (coronal holes) were investigated. It was found that for the period from January 1972 through January 1973 a significant enhancement in geomagnetic activity (Ap increase of nearly a factor of 2) occurred 2–3 days after central meridian passage of large coronal holes that extended to within 5° of the solar subearth point when they were on the meridian. Neither bright coronal features nor sunspots nor bright calcium plage regions showed such a correlation. Large coronal holes, which are frequently recurrent long lived features, appear to satisfy the requirements for "M regions," which were hypothesized to be responsible for recurrent geomagnetic disturbances (Bartels, 1934). If solar wind high speed streams originate preferentially in these regions, their velocity at the base of the corona will be substantially higher than that expected from an axisymmetric solar wind model. (auth)

1477 EXPERIMENTAL MEAN LIVES FOR Mn I, II, AND III, AND THEIR IMPLICATIONS FOR A REVISED MANGANESE SOLAR ABUNDANCE. Pinnington, E. H.; Lutz, H. O. (Institut fuer Kernphysik, Juelich, Ger.). Can. J. Phys.; 52: No. 14, 1253-1260 (15 Jul 1974).

A discussion is presented of beam foil mean lives for 9 terms of Mn I, 5 terms of Mn II, and 4 terms of Mn III. Attention is given to the energy loss sustained by the ions in the foil and to the limitations imposed by the finite time resolution of the technique. Transition probabilities derived from these mean lives are compared with those obtained by a variety of experimental and theoretical techniques; generally good agreement was obtained with values previously suggested by Allen, by Martinson et al., by Blackwell and Collins, and by Woodgate. The values are also used, in conjunction with several curves of growth discussed previously and a new branching-ratio measurement, to derive a revised value of the photospheric abundance of manganese given by log N(Mn) = 5.34 ± 0.08. (auth)

1478 PIONEER 10 OBSERVATIONS OF THE SOLAR WIND INTERACTION WITH JUPITER. Wolfe, J. H. (National Aeronautics and Space Administration, Moffett Field, CA); Mihalov, J. D.; Collard, H. R.; McKibbin, D. D.; Frank, L. A.; Intriligator, D. S. J. Geophys. Res.; 79: No. 25, 3489-3500(1 Sep 1974).

Detailed analysis of the Pioneer 10 plasma analyzer experiment flight data during the Jupiter flyby in late November and early December 1973 was performed. The observations show that the interaction of Jupiter's magnetic field with the solar wind is similar in many ways to that at earth, but the scale size is over 100 times larger. Jupiter is found to have a detached standing bow shock wave of high Alfvén Mach number. Like the earth, Jupiter has a prominent magnetopause that deflects the magnetosheath plasma and excludes its direct entry into the Jovian magnetosphere. Unlike that of the earth, the sunward hemisphere of Jupiter's outer magnetosphere is found to be highly inflated with thermal plasma and a high beta region that is highly responsive to changes in solar wind dynamic pressure. Observational arguments are presented that tend to discount a thin disklike magnetosphere and to favor a Jovian magnetosphere, albeit one probably considerably flattened in comparison with the earth's magnetosphere, yet still with reasonable thickness. Results concerning the shock jump conditions, the magnetosheath flow field, and inferred internal magnetospheric plasma are presented. (auth)

1479 20 MOMENT GRAD METHOD AND THE CGL INVARIANTS. Application to the Solar Wind. Fridman, M. (Univ., Liege). Can. J. Phys.; 52: No. 14, 1358-1368(15 Jul 1974). (In French).

The experimental data of the quiet solar wind appear to be the result of perturbations over the simple expansion of the solar plasma. The distribution function obtained by the 20 moments Grad method, but simplified by the parallel flux, was proposed by Whang to interpret the experimental data of Hundhausen. This distribution was used to close the moments system of a simple expansion which gives the perpendicular and parallel contribution to the parallel heat flux. The terms in the development which immediately follow the CGL invariants are obtained. The numerical value of the heat flux agrees with Whang's and Hundhausen's, and the corrections to the invariants are in agreement with the kinetic results of Hollweg and HD of Fridman if the closure of the moments system is made by the highly supersonic flux condition. (auth)

1480 INTERFEROMETER OBSERVATIONS OF SOLAR MILLIMETER WAVE BURSTS ON 2 AUGUST 1972. Ogawa, H.; Kawabata, K. (Nagoya Univ., Japan). Rep. Ionosphere Space Res. Jap.; 27: No. 4, 153-155(1973).

Solar radio bursts on August 2, 1972 are described, which were observed with the eight elements adding interferometer at 8.6 mm wavelength (35.0 GH_Z) of the Department of Physics, Nagoya University. The interferometer consists of eight fixed paraboloidal reflectors with Casegrain feed systems and eight plane reflectors on equatorial mountings. Two major bursts were observed on August 2, 1972. The first burst started at 0327 U.T. coinciding with the flare of importance 1B which had started at 0316 U.T. The radio burst had two peaks with almost same maximum flux density, and was followed by post increase lasting more than 90 minutes. The second radio burst was recorded at 2127 U.T. and showed very simple variation of flux density. The reports on H^{α} flare data (Solar Geophysical Data) indicate that the H^{α} flare of importance 2B had already started at 1958 U.T., and attained its maximum phase at 2058 U.T. The recording of the present observation started at 2113 U.T., and the first scanning of active region was made at 2120 U.T. The record of the first scanning did not show any indication of the occurrence of the radio burst, although the interferometer was partly shadowed by trees. The second scanning at 2127 U.T. clearly showed the occurrence of the burst. The results of the observation are shown in a table. Comparison of the position of the radio bursts with the sketches of sunspots is shown. An enlarged sketch of sunspot group and the neutral line of magnetic field are also shown. (JA)

1481 FINE STRUCTURE OF SOLAR WIND. Nishida, A. (Tokyo Univ.). Uchusen Kenkyu; 18: No. 1, 41-46(Aug 1973). (In Japanese).

Various phenomena due to the variations of the magnetic field in solar wind have been observed. These phenomena are expected to elucidate the heating mechanism of the turbulent flow of solar corona. The power spectral density observed in the planetary space in the vicinity of the earth is shown. The spectrum is ex-

pressed as $f^{-\alpha}$ where f is frequency, and the value of α is 1 for the frequency lower than 3×10^{-4} Hz, 1.5 for the frequency up to 1×10^{-1} Hz, and 2 for higher frequency. Existence of Alfvén wave was confirmed. The spatial scale of Alfvén wave is obtained by the observation with two artificial satellites. The scale is about 100 R_E when the velocity of solar wind is slower than 500 km/sec, and is less than 20 R_E when the velocity is high. It is considered that the variation of relatively fine scale exists in the region of corona which is at the origin of fast solar wind. Data of magnetic sound wave have scarcely been analyzed. The magnetic sound wave seems to be excited in the region where fast solar wind collides with slow speed region. An example of the observation of contact discontinuous surface is shown. Some discontinuous surface which shows the variation of direction only is also known. The power spectral density of wave due to the shock wave in front of magnetic space was obtained and is shown, but its excitation mechanism is still unknown. (JA)

1482 USE OF A METHOD OF ANALYTICALLY REPRESENTING RANDOM FIELDS IN STUDYING THE SOLAR SURFACE. Kerimbekov, M. B.; Magerramov, V. A. Tsirk. Shemakh. Astrofiz. Observ.; No. 30-31, 3-7(1973). (In Russian).

The study of changes taking place on the surface of the sun, in particular the evolution of solar formations, has to deal with problems of contours and characteristic sizes. The contours are the places of the greatest gradient in density of blackening. By an analytical representation it is possible at a glance to present the variable part of the solar surface in two dimensions, and also to find the true sizes of the formations. The method is applicable to large-scale structures observable on the visible surface of the sun. A square section of the photosphere is subdivided into 16 smaller squares. Series of films are obtained in 30 second intervals. In order to determine the change in the field of optical densities $D = f(x,y)$, the function $f(x,y)$ is presented in the form of a second-degree polynomial. Partial derivatives represent changes in density gradients. Since the gradients are vectors normal to the surface, the two-dimensional figure shows how the surface profile changes in time and in space. From the spacial variation it is possible to determine the dimensions of the formations. (SJR)

1483 SPECTROSCOPIC STUDY OF DYNAMIC PHENOMENA IN SUNSPOTS. Schultz, R. B. Boulder, CO; Univ. of Colorado (1974). 270p. University Microfilms Order No. 74-22,388.

Thesis (Ph. D.).

Some recently discovered dynamic phenomena in sunspots are studied with a view toward understanding the physical processes responsible for these events and the mechanical energy transport mechanisms important in the overall energy balance of sunspots. Spectrograph observations with high spatial and temporal resolution were made in a number of sunspots using the Vacuum Tower Telescope at Sacramento Peak Observatory. Fraunhofer lines of various strengths were used in order to probe the sunspot atmosphere at various heights. The CaII-K line profiles during an umbral flash exhibited a systematic variation in space and time which is interpreted in a first-order approximation as a vertical velocity oscillation of a large fraction of the sunspot umbra. The variations of the H-α line profile are not well correlated with the umbral flashes observed in the CaII-K line. The umbral magnetic field was analyzed using the FeI 6173 A Zeeman sensitive line, and no correlation was found between variations of the magnetic field strength and the umbral flashes. From these measurements, an upper limit of 1.8×10^8 ergs cm^{-2} sec^{-1} was placed on the energy flux of Alfven waves propagating upward through the umbra. Vertical velocity oscillations of the umbra were observed in the FeI, g = 0, 3767 A line with periods of 180 and 300 sec. and peak-to-peak amplitudes of about 0.5 km/sec. These observations place restrictions on the modes of mechanical energy transport that can couple the umbral flashes to the subphotospheric oscillations that have been proposed as possible energy sources for the flashes. In addition, the mechanical energy fluxes associated with the periodic phenomena currently observed in sunspots are found to be insignificant compared to the radiative energy deficit of sunspots. (Diss. Abstr. Int., B)

1484 THREE-DIMENSIONAL SOLAR WIND MODELING. Nerney, S. F. Boulder, CO; Univ. of Colorado (1974). 226p. University Microfilms Order No. 74-22,378.

Thesis (Ph. D.).

A steady, axisymmetric, nondissipative, three-dimensional solar wind model is investigated through the use of a perturbation expansion in inverse Rossby numbers (the ratio of the Coriolis force to the inertial term). Numerical results are presented only for the polytropic approximation, however, the solutions far from the sun are independent of this approximation. The meridional velocity at large r is of order $-2\sin 2\theta$ km/sec where θ is the polar angle, and this is consistent with the comet-tail analysis of Brandt, Harrington, and Roosen [1973] who find -2.6 ± 1.2 km/sec at 1 AU and $\theta = \pi/4$. The meridional magnetic pressure gradient causes mass to be transported away from the equator creating an apparent sink in the two-dimensional continuity equation there. The mass loss in the equatorial plane is estimated to be a 10 to 20 percent effect at 5 AU growing logarithmically to considerably larger values at greater distances. This secular growth is so slow that the linearization is probably valid out to the heliosphere. Energy is also channeled from Maxwell stresses into the radial velocity in the equatorial plane. Over the poles, the radial velocity is decreased from spherically symmetric values with an increase in magnetic flux there. Two-dimensional models that include the effects of v_θ^2 and B_θ^2 but neglect meridional effects are shown to be incorrect as the energy in the meridional flow was neglected while the increase in the radial velocity was overestimated. When latitudinally dependent boundary conditions are imposed in the zeroth-order, then more general large r solutions are allowed in the second-order equations. If one chooses a Parker radial velocity field and a radial magnetic field proportional to $\cos\theta$, the meridional velocity changes direction at the zero of the second legendre polynomial ($\theta \approx 55°$). (Diss. Abstr. Int., B)

1485 NUMERICAL STUDY OF PROTOSTELLAR FORMATION. Westbrook, C. K. Davis, CA; Univ. of California (1974). 96p. University Microfilms Order No. 74-21,640.

Thesis (Ph. D.).

The earliest phase in the evolution of a star is the formation of a gravitationally bound gas cloud from the interstellar medium. This cloud mass is not, in general, in hydrostatic equilibrium and will evolve hydrodynamically until equilibrium is attained. The protostellar evolution of these gas clouds is examined. A mathematical model is presented, treating all of the appropriate physical processes which are important during protostar formation, including hydrodynamics, thermodynamics and equation of state, radiation transport, and convective energy transport. Important features of the mathematical model are use of temperature or specific energy density as an independent parameter rather than energy flux or luminosity, and inclusion of all time derivatives from the differential equations. These provisions cast the stellar structure equations into the form of an initial value problem that can be evolved in time. A numerical model is then developed. An important feature of the difference equations is their ability to evolve configurations which are far from radiative, convective, or hydrodynamic equilibrium. This feature is a direct result of the form presented for the differential equations. This numerical model is applied to a wide range of initial conditions. The evolution of cloud masses from 0.01 to 50 solar masses is investigated. Results of evolutionary calculations are presented which are consistent with the existence of a lower mass limit for formation of main sequence stars. Other results for large mass clouds demonstrate mechanisms which severely limit the maximum size for stable stars. Calculations for one solar mass protostars are compared with calculations in the astrophysical literature and indicate that such a protostar first appears as a stellar object with an effective temperature of about 3100 °K and a luminosity of about 500 times that of the sun. All of the calculations included assumed spherical symmetry. Convective energy transport is treated with mixing length theory which has been extended to deal with conditions far from convective equilibrium by the introduction of a convective flux limiter. A numerical model is developed for material in hydrostatic equilibrium, with radiative and convective energy transport, coupling implicitly all of the stellar structure equations into one system. This system of numerical equations is then joined when necessary to the decoupled hydrodynamics and energy balance equations at the boundary of the region which is in hydrostatic equilibrium. All of these numerical models allow the evolution to be followed far beyond the stage where previous calculations in the literature had to be terminated. These calculations are therefore able to include the entire evolution of a protostar from its formation until well into the quasistatic contraction phase in a single consistent numerical treatment. (Diss. Abstr. Int., B)

1486 UNUSUAL SOLAR WIND AND SOLAR PROTON EVENTS OBSERVED ON THE LUNAR SURFACE. Medrano-Balboa, R. A. Houston, TX; Rice Univ. (1974). 199p. University Microfilms Order No. 74-21,308.

Thesis (Ph. D.).

Observations of interplanetary ions made by the Rice University Suprathermal Ion Detector Experiments (SIDEs) which form part of the Apollo Lunar Surface Experiment Packages (ALSEPs) are reported. None of the detectors of the SIDEs look directly into the solar wind. Therefore the instruments can only detect deviated solar wind ions or cosmic rays that are able to penetrate the

shielding of the detectors. Two events of these types were detected by the experiments. The first event (November 19, 1970) was observed by the Apollo 12 ALSEP–SIDE and consisted of the detection of ions from 26.3° off the normal wind direction. The data of this event were least squares fitted using an analytical approximation here named Parabolic Hypersurface Approximation. The results of the fit combined with two other experiments show that the disturbance was due to the passage of a tangential discontinuity whose characteristics fit surprisingly well with theoretical prediction. There is a considerable enhancement in the helium abundance and probably of heavier elements in the region following the discontinuity. It is, furthermore, identified with the driver gas of a flare-induced shock wave. The second event corresponds to the exceptional solar active period of early August 1972 when all three SIDEs (Apollos 12, 14 and 15) were past their local sunsets. The observations consisted of detecting solar wind ions from 70° off the normal solar wind directions and solar protons with energies (>25 MeV and >50 MeV) that were able to penetrate the shielding of all detectors. The plasma activity is associated with the arrival of one of the first flare-originated shock wave. Extremely high fluxes of solar protons (highest ever detected by our instruments) masked the wind ion observations. Of particular interest in this part of the event is the occurrence of a "square wave" flux enhancement of 2 hours duration. Data from a variety of ground based and space experiments in relation to the square wave were examined. Based on the results of this investigation a model relating the square wave with the flare plasma propagation is proposed. The model hypothesizes transport of energetic particles along a "corridor" formed by the tangential discontinuity produced by the driver gas. This model could explain the frequently observed delayed solar particle events. (Diss. Abstr. Int., B)

Galaxies

Refer also to abstracts 145, 1428, 1430, 1431, and 1625.

1487 (N-74-20457) INVESTIGATION OF GAMMA RAYS FROM THE GALACTIC CENTER. Final Report. Helmken, H. F. (Smithsonian Astrophysical Observatory, Cambridge, Mass. (USA)). Nov 1973. 15p. (NASA-CR-137384). NTIS $4.00.

Data from Argentine balloon flights made to investigate gamma-ray emission from the galactic center are summarized. Data are also summarized from a Palestine, Texas balloon flight to measure gamma rays from NP 0532 and Crab Nebulae. (auth)

1488 RADIO GALAXIES AND THE INTERGALACTIC MATERIAL IN CLUSTERS. Jaffe, W. J. Leiden; Rijksuniversiteit (1974). 85p.

Thesis.

Two models are developed for the formation of "tailed" radio sources like 3 C 129. Both models assume that the tails are the result of the rapid motion of an active galaxy through the relative dense gas in a cluster of galaxies. The first model is a modification of current models of normal symmetrical double radio sources, with the effects of the motion of the parent galaxy and of the thermal pressure of the intracluster gas included. The second model assumes that the galaxy has a long, permanently attached, magnetospheric tail, similar to the geomagnetic tail, generated by the action of the intracluster gas flow on the intrinsic magnetic field of the galaxy. Maps are presented at 1415 MHz and 5 GHz of 5 C 4.81 and 5 C 4.85 (in the Coma Cluster), 3 C 338 (in Abell 2199) and 4 C 17.66 (in the Hercules Cluster) obtained with the Westerbork Synthesis Radio Telescope. New results are: 1) 5 C 4.85 is resolved into a close double. 2) The tail of 5 C 4.81 has a width of less than 2 kpc in the first 20 kpc of its length. 3) 3 C 338 has an unresolved component associated with the nucleus of the most massive of the 4 galaxies in the NGC 6166 system. 4) The extended component of 3 C 338 is well resolved into an unusual double source. 5) 4 C 17.66, associated with NGC 6047, is resolved into an elongated object with relatively high linear polarization. Using the thermal bremsstrahlung interpretation of the X-ray measurements from the Coma Cluster, the present mass and potential energy of the intra-cluster medium (ICM) are calculated to be 1×10^{48} g and -2.6×10^{64} erg, respectively. The internal energy of this material is predominantly in the form of the thermal energy of the hot gas. It has been found that evolved massive stars in the cluster galaxies provide 20 to 40% of the current material; the rest was presumably present in the ICM at the time of galaxy formation. (NL)

1489 INTERSTELLAR MOLECULES AND THE PROBLEM OF LABORATORY DATA. Turner, B. E. (National Radio Astronomy Observatory, Charlottesville, Va. (USA)). Astrophys. Space Sci.; 29: No. 2, 247-265(Aug 1974).

The use of interstellar molecules as probes of physical conditions in interstellar clouds is hampered by the lack of basic laboratory data. The excitation of interstellar molecules is poorly understood because the nature of the interaction of molecules with radiation and with neutral particles is largely unknown. The mechanisms of formation and destruction of interstellar molecules are presently speculative, because little data exists in such areas as gas-phase ion-molecule reactions and exchange reactions, and reactions of various types on surfaces. Specific needs with regard to laboratory data are discussed in these and other areas. (auth)

1490 ON EXTINCTION BY SMALL GRAPHITE, SILICATE AND IRON PARTICLES. Morgan, D. H.; Nandy, K. (Royal Observatory, Edinburgh (UK)). Astrophys. Space Sci.; 29: No. 2, 285-290(Aug 1974).

The refractive indices of graphite, silicate, and iron, which are believed to be candidates for interstellar dust grains, are shown to exhibit large experimental uncertainties. The Mie scattering theory has been used to demonstrate how errors in the refractive indices are manifested in the extinction curves for small spheres in the wavelength range from 0.1 μm to 2 μm. It is found that the transmitted errors in the extinction curves are wavelength dependent: for graphite, significant errors occur in the far ultraviolet part of the extinction curve; for silicates, in the near ultraviolet; while for iron the error is relatively small in the wavelength range considered. (auth)

1491 LUMINOSITY FUNCTION OF E–S0 GALAXIES IN RICH CLUSTERS. Krupp, E. C. (Univ. of California, Los Angeles). Publ. Astron. Soc. Pac.; 86: No. 512, 385-389(Aug 1974).

Apparent visual magnitudes and Hubble types are estimated for galaxies with $m_v \leqq 16.75$ within the 43 clusters of richness class 1 or greater and distance classes 1 through 3 in Abell's statistical sample of rich clusters. The luminosity functions of the E–S0 components of 27 of these clusters are fitted together to generate a mean luminosity function for E–S0 galaxies in rich clusters, for which relative distances and relative richnesses are obtained. (auth)

1492 REVIEW OF SPIRAL STRUCTURE IN THE NORMA REGION. Rydgren, A. E. (Univ. of Arizona, Tucson). Publ. Astron. Soc. Pac.; 86: No. 512, 363-379(Aug 1974).

The available material on optical and radio spiral tracers in the Norma region ($320° \leq l < 340°$, $-5° < b < +5°$) is reviewed and compared to the spiral structure maps of Kerr (1969) and Courtès et al. (1970). The observations are not entirely consistent with either of these pictures of the spiral structure in this region. (auth)

1493 DENSITY-WAVE THEORY OF THE SPIRAL STRUCTURE OF GALAXIES. Wielen, R. (Astronomisches Rechen-Institut, Heidelberg). Publ. Astron. Soc. Pac.; 86: No. 512, 341-362(Aug 1974).

This article reviews the gravitational interpretation of the spiral structure of galaxies in terms of density waves. After stating the basic problems to be explained, the theory of density waves in stellar and gaseous disks of galaxies is described and the merits and difficulties provided by the concept of density waves for the present understanding of spiral galaxies are discussed. (auth)

1494 MILLIMETER-WAVELENGTH MOLECULAR LINES AND FAR INFRARED SOURCES. Morris, M. (Univ. of Chicago); Palmer, P.; Turner, B. E.; Zuckerman, B. Astrophys. J.; 191: No. 2, 349-355(15 Jul 1974).

Millimeter-wavelength emission lines of HCN and CS were detected in many galactic sources of far-infrared radiation. These sources can be divided into two classes: those which do not have associated with them radio continuum emission from a compact H II region, and those which do. An extensive map of the $J = 1 \rightarrow 0$ HCN and CS emission from the W75 region suggests that molecules have comparable concentrations in the two classes of sources which may represent different stages in the formation of massive stars and star clusters. Consequences of the association of molecular sources and far-infrared sources are discussed in terms of early stellar evolution. The W75 map and similar ones of W3, NGC 2024, and NGC 2264, show that the molecular emission is extended over much larger regions than previously realized, and consequently very large masses ($\gtrsim 10^4$ to $10^{5.5}$ $M_\odot$) are implied if the molecules are collisionally excited throughout the cloud. (auth)

1495 OPTICAL ABSORPTION OF SOLID GRAINS IN ASTROPHYSICAL ENVIRONMENTS. Stein, W. A. (Univ. of California, San Diego); Ney, E. P. Publ. Astron. Soc. Pac.; 86: No. 512, 380-384(Aug 1974).

The optical absorptivity of grains of solid material in infrared sources is investigated by the comparison of calculated and observed temperatures and distances of the grains from the source of illumination. It is found that for the few sources for which appropriate measurements have been made the calculated distances of blackbody particles agree well with the measured values—a result which could lead to misleading conclusions about grain properties. The ratio of optical absorptivity to infrared emissivity is calculated for several sources taking into account expected effects of real grain materials. The measured angular size of dust shells surrounding stars can lead to information about the optical properties of grains under astrophysical conditions. (auth)

1496 INFRARED POLARIZATION OF NGC 1068. Knacke, R.F. (Department of Earth and Space Sciences, State University of New York at Stony Brook); Capps, R.W. Astrophys. J. Lett. 192: No. 1, L19-L22 (15 Aug 1974).

Polarization at 3.5 and 10.2 μ has been observed in the Seyfert galaxy NGC 1068. Possible polarization mechanisms are discussed. (auth)

1497 THE NEW MOLECULAR CLOUD IN ORION. Morris, M. (University of Chicago); Zuckerman, B.; Turner, B.E.; Palmer, P. Astrophys. J. Lett. 192: No. 1, L27-L30 (15 Aug 1974).

In a recently discovered infrared cluster about 12′ north of the Kleinmann–Low (KL) infrared nebula in Orion, we have detected microwave emission from $H^{12}CN$, $H^{13}CN$, NH_3, U89.2, and U90.7. Three outstanding characteristics of this cloud are: (1) strong millimeter–wavelength lines of HCN, U89.2, and U90.7 with intensities comparable to, though somewhat less than, the same lines in the KL nebula, (2) very narrow line widths ($\lesssim 1.7$ km s^{-1}), which have allowed us to obtain improved rest frequencies for U89.2 and U90.7 and improved limits on any hyperfine structure in these lines, and (3) a north–south ridge observed in HCN that extends over a very large area ($\sim 5' \times 18'$ to one–third power) from the south where it joins with the well–known Orion molecular cloud to at least 25′ north of KL. Analysis of line widths and velocity gradients across the source suggests that collapse, expansion, and rotational motions are not important line broadening effects, leaving turbulence to account for the observed line widths. (auth)

1498 1–MILLIMETER CONTINUUM RADIATION FROM ORION MOLECULAR CLOUD 2. Werner, M.W. (Hale Observatories, California Institute of Technology, Carnegie Institution of Washington); Elias, J.H.; Gezari, D.Y.; Westbrook, W.E. Astrophys. J. Lett. 192: No. 1, L31-L32 (15 Aug 1974).

The 1–mm continuum flux from Orion Molecular Cloud 2 has been measured with a 1′ beam and is 0.05 ± 0.01 of that from the Becklin–Neugebauer/Kleinmann–Low complex. This implies that the average density of dust within OMC–2 is about an order of magnitude less than within the BN/KL region. (auth)

1499 HYDROGEN CHLORIDE IN DENSE INTERSTELLAR CLOUDS. Dalgarno, A.; De Jong, T.; Oppenheimer, M.; Black, J.H. (Center for Astrophysics, Harvard College Observatory and Smithsonian Astrophysical Observatory). Astrophys. J. Lett. 192: No. 1, L37-L39 (15 Aug 1974).

The chemical formation and destruction of HCl in interstellar clouds is discussed. It is shown that in diffuse clouds only a small fraction of the chlorine is in the form of HCl but in dense clouds the reaction of Cl with H_3^+ leads to the conversion of most of the chlorine to HCl. It is argued that despite its much lower abundance, HCl may cool dense clouds with nearly the same efficiency as CO. Other molecules containing hydrogen may also be efficient sources of energy loss in dense clouds. (auth)

1500 DETECTION OF THE J=1–0 ROTATIONAL TRANSITION OF VIBRATIONALLY EXCITED SILICON MONOXIDE. Thaddeus, P.; Mather, J. (Goddard Institute for Space Studies, New York City); Davis, J.H.; Blair, G.N. Astrophys. J. Lett. 192: No. 1, L33-L36 (15 Aug 1974).

The v=1, J=1–0 rotational transition of SiO at 43.1 GHz has been detected in the direction of Becklin's star in the Orion Nebula, and in the M–type star W Hya. In Orion two velocity components are observed, one (the stronger) at a radial velocity of 17 km s^{-1}, the other at -7 km s^{-1}; in W Hya a single line is observed at 39 km s^{-1}. In each case a line at the same radial velocity has been observed at 86.2 GHz in the v=1, J=2→1 transition, so that the presence of vibrationally excited SiO would seem to be confirmed beyond a reasonable doubt. In the v=1 state, the photon fluxes of the J=2→1 and 1–0 transitions are about equal, suggesting saturated masers occupying the same region of space. (auth)

1501 RELATIONSHIP BETWEEN THE GRADIENT OF THE SURFACE BRIGHTNESS AND OTHER CHARACTERISTICS OF SEYFERT GALAXIES. Arakelyan, M. A. (Astrophysical Observatory, Moscow). Astrophysics (Engl. Transl.); 8: No. 4, 368-369(1972).

Translated from Astrofizika; 8: No. 4, 624-627(1972).

An important parameter that distinguishes Seyfert galaxies from normal galaxies was pointed out by Zasov and Lyutyi. They showed that the gradient of the surface brightness in Seyfert galaxies is much greater on the average than for normal galaxies. In this connection the relationship between this parameter and other manifestations of the activity of Seyfert galaxies was considered. (WDM)

1502 SPECTRAL INVESTIGATION OF THE GALAXY MARKARYAN 8. Khachikyan, E. E. (Astrophysical Observatory, Moscow). Astrophysics (Engl. Transl.); 8: No. 4, 311-316 (1972).

Translated from Astrofizika; 8: No. 4, 529-539(1972).

The results are given of a detailed spectral investigation of the galaxy Markaryan 8. Photographs were obtained with the 84″ telescope of the Kitt Peak National Observatory by means of Lynds's spectrograph (dispersion ~120 Å/mm). Seven spectra of different parts of the galaxy were obtained with parallel displacement of the spectrograph slit along right ascension. The galaxy has a complicated morphological and dynamical structure. It contains several superassociations whose redshifts differ appreciably. The velocity field in the galaxy, which is unusual, was investigated. (auth)

1503 VARIABILITY OF THE OPTICAL EMISSION OF THE NUCLEI OF SEYFERT GALAXIES. Babadzhanyants, M. K.; Gagen-Torn, V. A.; Lyutyi, V. M. (Leningrad State Univ.). Astrophysics (Engl. Transl.); 8: No. 4, 300-310(1972).

Translated from Astrofizika; 8: No. 4, 509-528(1972).

Comparison of results of spectral, photometric, and polarization observations of the nuclei of Seyfert galaxies indicates that the nuclei of these galaxies contain small-diameter sources of synchrotron radiation that are responsible for the observed variability of the optical emission and its polarization. In all probability, the variability is due to a change in the maximal energy of relativistic electrons. These sources do not have a direct relationship to infrared excesses and because of their small diameter their radiation is already self-absorbed at low-centimeter wavelengths. (auth)

1504 INTERSTELLAR MOLECULES. Lequeux, J. (Observatoire, Paris). Bull. Union Physiciens; 68: No. 564, 777-788(Apr 1974). (In French).

The different stages in the discovery of interstellar molecules are reviewed. The mechanisms involved in the creation and destruction of these molecules explains why most of the molecules found in the interstellar environment are organic. These molecules exhibit three types of energy level: electronic, vibrational, and rotational. Because of the temperature of the interstellar environment, the observed transitions can, in general, be predicted without considering the vibrational and electronic energy levels. In astrophysics, the density and temperature of the various layers inside a molecular cloud are determined from the spectral lines corresponding to the different molecules present. (FR)

1505 GALACTIC CLOUDS OF ORGANIC MOLECULES. Buhl, D. (National Radio Astronomy Observatory, Green Bank, WV). Space Life Sci.; 5: No. 1-2, 29-40(1974).

The discovery of immense organic clouds of gas embedded in the dusty regions of our galaxy is of tremendous importance to the origin of life. It is within these clouds that the formation of stars and planetary systems is believed to take place. The collapse of these clouds to form stars takes place in a very small fraction of the astronomical lifetime of a star. It is precisely at this moment that the clouds of organic molecules appear. (NL)

1506 ACCRETION FLOWS ONTO GALACTIC X-RAY SOURCES. Buff, J. S. Boulder, CO; Univ. of Colorado (1974). 208p. University Microfilms Order No. 74-22,323.

Thesis (Ph. D.).

Gas flows onto galactic x-ray sources are investigated with several simple models. The temperature and ionization state of the gas is found by requiring local balance of heating and ionization. Radiative transfer is performed to find the x-ray spectrum. Spherically symmetric accretion flows in the presence of a strong x-ray source are discussed. The mass accretion rate is regulated by the location of the sonic surface, which depends on x-ray luminosity and spectrum. No steady flow is possible in the spherically symmetric case. Radiation pressure on the gas due to photoionization may exceed that due to Compton scattering by a large factor and reduce the limiting luminosity below the Eddington limit. The preferential absorption of soft x-rays is evident in the emergent x-ray spectrum. Some of the absorbed radiation appears as optical and ultraviolet emission lines. The results obtained from the spherically symmetric models are applied to more complex models in a qualitative way. If x-ray stars in binary systems are powered by accretion of gas from a stellar wind, they should have soft x-ray cutoffs in the observable

range (0.25 to 5 keV) which vary in a predictable way according to the radius and inclination of the binary orbit. (Diss. Abstr. Int., B)

1507 CHEMICAL COMPOSITION OF SELECTED H II REGIONS IN THE MAGELLANIC CLOUDS. Dufour, R. J. Madison, WI; Univ. of Wisconsin (1974). 150p. University Microfilms Order No. 74-16,203.

Thesis (Ph. D.).

An investigation of the optical spectra and elemental abundances of 14 H II regions in the Large (LMC) and Small (SMC) Magellanic Clouds is presented. The photographic and photoelectric observations of the spectra of 3 SMC and 11 LMC H II regions were obtained at Cerro Tololo Observatory in 1972 December and 1973 January. From the emission line strengths corrected for interstellar reddening the relative abundances of hydrogen, helium, nitrogen, oxygen, neon, sulphur, chlorine, and argon are calculated. (MHR)

1508 STUDIES OF RICH CLUSTERS OF GALAXIES. I. Galaxy Counts for Nine Clusters of Intermediate Redshift and the Angular Diameter-Redshift Relation. Austin, T. B.; Peach, J. V. (Oxford Univ.). Mon. Notic. Roy. Astron. Soc.; 167: No. 3, 437-456(Jun 1974).

Counts of galaxies in the fields of nine rich clusters with z ranging from 0.13 to 0.20 have been made on V plates taken with the Palomar 48-in. Schmidt telescope. The surface density of galaxies as a function of distance from the cluster centre is discussed in the context of three previously suggested approaches to a definition of angular size. Least-squares fits of the data to the projected isothermal gas sphere lead to a parameter β characterizing the radius of the cluster core. The mean distance of galaxies from the line of sight through the cluster centre, $\bar{r}$, is a measure characterizing the size of the cluster as a whole. The use of secondary maxima in the density distribution is considered and dismissed. $R_{\bar{r}}$ and $R_{\beta\beta}$, the intrinsic cluster and core radii in Mpc, are found to be related through the empirical equation $R_{\bar{r}} = (0.31 \pm 0.02)R_{\beta\beta}^{\frac{1}{2}} + (4.36 \pm 0.49 \times 10^{-3})N_{SH} - (0.14 \pm 0.09)$ where N_{SH} is the cluster population. This equation is used to define a new measure of angular radius $\bar{r}_c$ by reducing the observed value of $\bar{r}$ to that which would be observed for a cluster of standard radius on the assumption that $R_{\beta\beta}$ and N_{SH} uniquely determine $R_{\bar{r}}$. A plot of $\bar{r}_c$ against z is given which shows a standard deviation of the residuals of $\bar{r}_c$ from a mean line with $q_0 = +1$ of only 18 per cent. It is suggested that the use of this parameter as a measure of angular size makes the angular diameter–redshift test using clusters of galaxies competitive with the apparent magnitude–redshift test using brightest cluster galaxies. (auth)

Cosmology

1509 (RRK-74-3) NONLINEAR BEHAVIOR OF NONSPHERICAL PERTURBATIONS IN RELATIVISTIC GRAVITATIONAL COLLAPSE. Tomita, K. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Jan 1974. 24p. NTIS (US Sales Only).

As a preparation for clarifying the final state of relativistic gravitational collapse, it is examined how nonspherical perturbations behave in the neighborhood of the Schwarzschild surface, by analyzing the second-order nonlinear perturbations as well as the first-order linear ones, and it is found that through the perturbations corresponding to incoming gravitational waves reflected by the potential barrier, the nonlinear effect becomes important, when the surface of the collapsing object approaches the Schwarzschild surface. This means that the conclusions about the final state derived in the linear approximation are questionable. It is concluded that however small the initial nonspherical perturbations are, full nonlinearity must be considered in order to analyze dynamical processes in the neighborhood of the final state. (auth)

1510 THEORY OF THE EXPANDING UNIVERSE. Hafner, H. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 26: No. 2, 175-211(1973). (In Rumanian).

The topics cover physical conception of curved space, cosmological transformation, expanding universe, a fluid real schema, time spending equation and conformal Robertson Walker metrics, and metrics of cosmological interest. (auth)

1511 ANISOTROPIC EXPANSION OF THE UNIVERSE AND THE ANISOTROPY AND LINEAR POLARISATION OF THE COSMIC MICROWAVE BACKGROUND. Anile, A. M. (Mathematics Department, Calabria University, Cosenza, Italy). Astrophys. Space Sci.; 29: No. 2, 415-426(Aug 1974).

The relativistic transfer equation for polarized radiation is solved in an axisymmetric Bianchi Type I universe. Previous results concerning the linear polarization induced in the cosmic microwave background radiation by Thomson scattering in an anisotropically expanding Universe are confirmed. (auth)

1512 SEARCH FOR RADIO AND OPTICAL BURSTS FROM CATASTROPHIC EVENTS. O'Mongain, E.; Weekes, T. C. (Harvard Coll. Observatory, Cambridge, MA). Publ. Astron. Soc. Pac.; 86: No. 512, 470-476(Aug 1974).

The 10-meter optical reflector at Mount Hopkins in southern Arizona is equipped with two 4.6-meter radio dishes. The combined antennas have been used to search for broadband electromagnetic pulses of duration 0.1 to 20 sec, from regions of high stellar density at three radio frequencies (378 MHz, 385 MHz, and 610 MHz) and one optical frequency. Dispersion by interstellar electrons causes a predictable time delay and pulse widening at the lower frequencies so that pulses of cosmic origin can be distinguished from interference pulses of local origin. The galactic center, the Coma cluster of galaxies, and the Andromeda galaxy were studied with null results. Broadband pulses might be expected to accompany the emission of bursts of gravitational radiation or gamma-ray bursts. (auth)

1513 NEW NEGATIVE RESULT FOR GRAVITATIONAL WAVE DETECTION AND COMPARISON WITH REPORTED DETECTION. Levine, J.L.; Garwin, R.L. (IBM Thomas J. Watson Research Center, Yorktown Heights, New York 10598). Phys. Rev. Lett. 33: No. 13, 794-797 (23 Sept 1974).

We report new negative results for detection of gravitational radiation with a 500-kg, 1637-Hz detector of demonstrated sensitivity and detection efficiency. These results are compared with numerous detections reported by Weber. We conclude that those detections did not arise from gravitational radiation. Furthermore, gravity waves (or other impulsive excitations) could not have produced data with a coincidence peak as narrow as that published in September 1973. (auth)

1514 STRUCTURE AND EVOLUTION OF THE UNIVERSE. Bicak, J. (Karlova Univ., Prague). Cesk. Cas. Fys.; 24: No. 5, 425-445(1974). (In Czech).

The basic postulate in cosmology is the Copernican principle: the Earth is not in a special position in space. Observations indicate that, on a scale large enough, the universe around us is homogeneous and isotropic so that the universe at large seems to be well described by the Friedmann models. Although we cannot say with a sufficient confidence which one of these models corresponds to the real world—whether e.g. the universe is closed or open—the observational cosmology, since the Hubble's discovery of the expansion, made an important progress in this classical question (in the latest years due primarily to the work of A. Sandage). However, the most significant discovery of the last decade was the detection of the universal microwave background radiation. It raised a number of new questions and connections in cosmology. In the conclusion, three other current problems are briefly touched on—the mean density of mass-energy in the universe, the origin of galaxies and the physics of the early universe. (auth)

1515 ORIGIN OF THE UNIVERSE. Kundt, W. (Univ., Bielefeld, Ger.). Cesk. Cas. Fys.; 24: No. 5, 446-461(1974). (In Czech).

The standard model of cosmology is the Friedmann–Lemaître universe with zero 3-space curvature whose matter content is near thermal equilibrium throughout the first 10^5 years (hot bang model). It leaves the photon to baryon number ratio unexplained, as well as the origin of cosmic fine structure. Alternatively, if the equation of state at extreme density is very soft, and hadronic decay slow, we have a non-equilibrium two-fluid substratum. In this case, equipartition of energy at the end of the long hadron decay would explain the photon to baryon ratio; and the graininess of matter would give rise to relativistic random motions which in turn are the cause of density fluctuations on subhorizontal scales. Progress in cosmology awaits progress in high energy physics. (auth)

1516 MOLECULES IN THE COSMIC SPACE. Vanysek, V. (Karlova Univ., Prague). Cesk. Cas. Fys.; 24: No. 5, 462-468 (1974). (In Czech).

A review of the study of the interstellar chemical constituents—a new research field involving astrophysics, physics, chemistry, and biology—is presented. The principles of microwave detection of molecules and their isotopic counterparts are discussed. The formation of diatomic and polyatomic molecules in the tenuous, almost empty galactic space is obviously a very difficult problem. However, there are some parallelisms between the interstellar and prebiotic chemistry and this research field may be one of the most promising developments of the astrophysical research in the future. (auth)

1517 COMMENT ON A PUBLICATION BY BRAMANTI, MAISCHBERGER, AND PARKINSON ON GRAVITY WAVE DE-

TECTION. Levine, J. L. (IBM Watson Research Center, Yorktown Heights, NY). Lett. Nuovo Cim.; 11: No. 4, 280-282(28 Sep 1974).

A negative result was previously reported for a gravitational-radiation detection experiment, their sensitivity being given in terms of the oscillation energy which would have been induced in the antenna by short pulses of radiation. It is believed that the sensitivity of the system to such pulses is greatly overstated by neglecting the effects of the filters used to reduce broad-band-width noise. The response of this system to an impulsive excitation of the antenna is calculated including the effects of the filters, sampling system, and the differencing algorithm. (JFP)

1518 ABSORPTION OF PHOTONS OF SUPERHIGH ENERGIES IN THE UNIVERSE. Matinyan, S. G. (Inst. of Physics, Erevan). Astrophysics (Engl. Transl.); 8: No. 4, 344-346(1972). Translated from Astrofizika; 8: No. 4, 587-590(1972).

Calculations are made of the probabilities of hadron absorption of γ rays in the gas of photons of the blackbody radiation and extragalactic radio radiation and on optical phonons of the radiation of the galaxies and on x rays. For $E\gamma \geq 10^{22}$ eV the contribution to the absorption of photons from the hadronic channels exceeds the contribution from the leptonic channels and is independent of the energy. It follows from the results that the Universe is opaque to γ rays with $E\gamma \geq 10^{14}$ eV. (auth)

1519 POLARIZATION OF THE BLACKBODY RADIATION AT 3.2 cm. Nanos, G. P. Jr. Princeton, NJ; Princeton Univ. (1974). 142p. University Microfilms Order No. 74-17,481. Thesis (Ph. D.).

A 3.2 Dicke Radiometer configured as a polarimeter was used to make measurements of the linear polarization of the Primeval Fireball along a declination of 40.35°N. The resolution of the instrument was 15° in declination and 1 hour in right ascension. Harmonic analysis of the Stokes parameters of the radiation, Q and U, sets limits on sidereal variations, which in turn limit the possible contributions of cosmological origin. Results are related to the isotropy of the cosmic background radiation and the symmetry of the Universe. (Diss. Abstr. Int., B)

1520 PROPAGATION OF NONLINEAR ELECTROMAGNETIC FIELD THEORIES. Shamaly, A.; Capri, A. Z. (Univ. of Alberta, Edmonton). Can. J. Phys.; 52: No. 10, 917-918(15 May 1974).

It is shown that the self-interaction term $\lambda(A_\mu A^\mu)^2$ added to the free Lagrangian for Maxwell's equations leads to acausal propagation. Furthermore, it is found that apart from the term $\lambda A_\mu A^\mu$ which leads back to the Proca equation, all self-interaction terms leading to causal propagation must be nonpolynomial. (auth)

1521 GRAVITATIONAL RADIATION AND ITS DETECTION. Papini, G. (Univ. of Saskatchewan, Regina). Can. J. Phys.; 52: No. 10, 880-901(15 May 1974).

A review is presented of the theoretical and experimental aspects of the field of gravitational radiation. This article, aimed particularly at showing that the problem of gravitational radiation can be tackled experimentally in various meaningful ways, includes, for completeness, a short theoretical introduction and a discussion of possible radiation sources. Several detection schemes are discussed and the experimental situation is reviewed, with attention to the questions it raises. (auth)

1522 STUDIES IN GRAVITATIONAL COLLAPSE. Chase, J. E. Edmonton, Alberta; Univ. of Alberta (1972). 107p. Thesis.

The relativistic gravitational collapse of an object is usually considered in four stages: instability, implosion, horizon, and singularity; and in three categories: spherical, nearly-spherical, or highly nonspherical. First some elementary results related to the instability stage of spherical collapse are presented. A solution of the Einstein equations is derived for a thin spherical shell of charged fluid falling in a spherically symmetric field due to mass and charge at its centre. No restrictions are placed on the equation of state. The equations of motion are integrated to find the law of conservation of total energy, and it is used to study the equilibrium states of the system, and their stability against collapse. Given the entropy, the equation of state, and reasonable assumptions, it is found that there is a maximum equilibrium mass and a critical radius, inside of which instability sets in. For uncharged bodies, these results completely parallel the more complicated analyses needed for fluid spheres. The second study is concerned with the implosion and horizon stages of nearly-spherical collapse. Two idealized collapse models (again thin shells), involving a scalar monopole and a magnetic dipole, are considered, treating departures from sphericity as small perturbations. Radiative leakage (largely downwards through the Schwarzschild horizon) causes the externally observable asymmetries to decay to zero in an oscillatory fashion. These results imply that a "black hole" cannot be a source of synchrotron radiation. Finally the horizon stage of highly nonspherical collapse is dealt with and static scalar fields are considered. The following is proven: every zero-mass scalar field which is gravitationally coupled, static and asymptotically flat, becomes singular at a simply-connected event horizon. (MGH)

1523 FROM THE BLACK HOLE TO THE INFINITE UNIVERSE. Goldsmith, D.; Levy, D. San Francisco; Holden-Day, Inc. (1974). 334p. $6.95.

Some of the more interesting aspects of astronomy and astronomy and modern physics are presented in a way that can be understood by readers with little or no scientific orientation or motivation. (WDM)

Planetary Phenomena

Refer also to abstracts 1373, 1486, and 1578.

1524 NEUTRON STRATIGRAPHY IN THE LUNAR REGOLITH. Russ, G. P. Pasadena, CA; California Inst. of Tech. (1974). 343p. University Microfilms Order No. 74-17,955. Thesis (Ph. D.).

Differences in the isotopic composition of Gd and Sm among lunar samples collected during the Apollo 11, 12, 14, 15 and 16 and Luna 16 missions have been measured by high precision mass spectrometry. These differences (up to 1.9% in $^{158}Gd/^{157}Gd$ and 2.0% in $^{150}Sm/^{149}Sm$) can be attributed unambiguously to low energy neutron capture reactions and correspond to neutron fluences as high as 10^{17} n/cm^2 (E < 0.18 eV). For the Apollo 16 samples, enrichments are reported for the $^{152}Gd/^{160}Gd$ ratio which appear to be due to neutron capture by ^{151}Eu. The measured ratio of the number of neutrons captured per atom by ^{149}Sm to the number captured per atom by ^{157}Gd indicates that the low energy lunar neutron spectrum is in reasonable agreement with that calculated by Lingenfelter, Canfield, and Hampel but that the lunar spectrum is somewhat harder. A synthesis of all the available lunar neutron capture data for ^{157}Gd, ^{155}Gd, ^{149}Sm, ^{151}Eu, ^{59}Co, ^{79}Br, ^{81}Br, ^{130}Ba, ^{186}W, ^{235}U, ^{238}U, and ^{40}Ca indicates that only the ^{186}W and ^{235}U data are incompatible with the LCH neutron spectrum and flux. Based on the LCH neutron flux, the neutron fluences, ψ, determined for the lunar soils are all lower than would be expected for materials mixed in the upper few meters of the regolith for > 3×10^9 yr. In terms of a uniform mixing model the measured neutron fluences imply that the depth of the regolith is between 10 and 14 m at all of the Apollo sites studied. These are greater than the depths implied from cratering theory. The $^{126}Xe/\psi$ ratios for the soils indicate that they have been well mixed to a depth of > 200 g/cm^2. Detailed fluence studies in the Apollo 12 double core show that these materials could not have been undisturbed for > 10^8 yr. The upper layers of the Apollo 15 and 16 drill stems also imply mixing on this time scale. However, the Apollo 15 drill stem has a smooth peak in the fluence at a depth of ~190 g/cm^2. From the magnitude of this peak, it can be concluded that below a depth of ~75 g/cm^2 these materials have been undisturbed for at least 400 my. The fluence profile in the Apollo 16 drill stem is more complicated but indicates an area where material has been accumulating for several hundred million years. A model is presented for the depth dependence of the ratio of ^{131}Xe produced by neutron capture on ^{130}Ba to ^{126}Xe produced by spallation reactions on Ba. Effective exposure depths are calculated for 24 rocks from Apollo 11 and 12. Detailed irradiation histories are presented for rocks 10017, 14310, and 15595. An erosion rate for Hadley Rille of ~1 cm/my is calculated from the neutron fluence of rock 15595. From Gd and Sm isotopic measurements it is shown that the Norton County meteorite has been exposed to a neutron flux with a spectrum compatible with that predicted by the LCH calculations. The neutron fluence to which our sample of Norton County has been exposed is 1.2×10^{16} n/cm^2. No neutron produced effects were observed in the isotopic composition of Gd from a bulk sample of the Allende meteorite. (Diss. Abstr. Int., B)

1525 JUPITER'S MAGNETOSPHERE AS OBSERVED WITH PIONEER 10. Van Allen, J. A.; Randall, R. F. (Univ. of Iowa, Iowa City). Astronaut. Aeronaut.; 12: No. 7-8, 14-21(1974).

The observations by the University of Iowa instrument and a preliminary analysis of them are discussed. It is found that Jupiter's magnetosphere consists of two quite different parts. This discussion covers particle intensities throughout both regions and marked depletion at the orbits of So, Europe, and Ganymede. (MHR)

1526 THE EVOLUTION OF JUPITER FROM A PROTOPLANET. Donnison, J. R.; Williams, I. P. (Queen Mary Coll., London (UK)). Astrophys. Space Sci.; 29: No. 2, 387-396(Aug 1974).

The evolution of an object of Jupiter mass contracting under

gravity while being heated at its outer surface by the Sun is considered. Degenerate pressure in its interior is included. It is found that a good agreement with the present effective temperature and luminosity of Jupiter is predicted. The derived age of the evolved body is not in contradiction with the ages of other objects in the Solar System. (auth)

1527 PLANETARY MAGNETIC FIELD AND MAGNETOSPHERE OF JUPITER: PIONEER 10. Smith, E. J. (Jet Propulsion Lab., Pasadena, CA); Davis, L. Jr.; Jones, D. E.; Coleman, P. J. Jr.; Colburn, D. S.; Dyal, P.; Sonett, C. P.; Frandsen, A. M. A. J. Geophys. Res.; 79: No. 25, 3501-3513(1 Sep 1974).

Data obtained by the Pioneer 10 vector helium magnetometer are presented along with models of the intrinsic magnetic field of Jupiter and its magnetosphere. Data acquired between 2.84 and 6.0 R_J, where the intensity of the planetary field ranged between 1900 and 18,400 γ, were used to develop a six-parameter eccentric dipole model of the field. The dipole so derived has a moment of 4.0 G R_J^3 and a tilt angle with respect to Jupiter's rotation axis of 11°. The system III (epoch 1957) longitude of the magnetic pole in the northern hemisphere, which is a north-seeking pole, is 222°. The dipole is displaced from the center of Jupiter by 0.11 R_J in the direction of latitude 16° and system III longitude 176°. The dipole tilt and the longitude of the pole are in good agreement with values inferred from radio astronomy measurements. The magnetic moment and the offset derived from the Pioneer measurements represent a significant improvement in knowledge of the planetary field. A model of the Jovian magnetosphere is presented in which the essential feature is an eastward current sheet that forms an annulus with Jupiter at the center. At large distances from the planet the current sheet is nearly parallel to Jupiter's equator but, in general, does not lie in it. The current sheet is warped, so that it is above the equator on one side and below it on the other. The current sheet rotates with the planet, more or less like a rigid body; this behavior causes an apparent up and down motion and periodic crossings of the current sheet by Pioneer. The origin of the current sheet appears to be the very large centrifugal force, associated with Jupiter's great size and rapid rotation, acting on trapped low-energy magnetospheric plasma. The density of this plasma is estimated to be approximately 1 particle cm^{-3}. A retrograde spiraling of field lines out of meridian planes is also observed, presumably as a result of azimuthal drag forces exerted on the outer magnetosphere. (auth)

1528 MAGNETIC COORDINATES FOR THE PIONEER 10 JUPITER ENCOUNTER. Mead, G. D. (Goddard Space Flight Center, Greenbelt, MD). J. Geophys. Res.; 79: No. 25, 3514-3521(1 Sep 1974).

The magnetic coordinates of the Pioneer 10 spacecraft and the five innermost satellites are given around the time of Jupiter encounter, December 1–8, 1973. The D_2 offset dipole model of Smith et al. (1974b) is used to make the calculations. Magnetic coordinates are needed for the interpretation of the trapped particle measurements, including the absorption effects of the satellites, reported on elsewhere. Contours of constant field magnitude and magnetic latitude are given at the surface of Jupiter for the D_2 model. The system III longitude of a spacecraft at Jupiter is derived and formulas are given for the relations between system I, II, and III longitudes. The longitude of the magnetic dipole increases by about 3°/yr owing to the inaccurate rotation rate used to define system III longitude. (auth)

1529 PROTONS AND ELECTRONS TRAPPED IN THE JOVIAN DIPOLE MAGNETIC FIELD REGION AND THEIR INTERACTION WITH Io. Simpson, J. A.; Hamilton, D. C.; McKibben, R. B.; Mogro-Campero, A.; Pyle, K. R.; Tuzzolino, A. J. (Univ. of Chicago). J. Geophys. Res.; 79: No. 25, 3522-3544(1 Sep 1974).

The University of Chicago experiment on board the Pioneer 10 spacecraft contains four sensor systems, three of which were used to study the trapped radiation region $R < 20\ R_J$. Two of the systems are of novel design. One is a silicon detector operated in the current mode surrounded by sufficient beryllium to stop protons with energies $\lesssim 30$ MeV. Electrons with energies $\gtrsim 3$ MeV were measured by this detector over an intensity dynamic range of $> 10^7$. Because of the great difficulty in identifying high-energy protons in the presence of an intense high-energy electron component, $\gtrsim 35$-MeV protons were measured by proton-induced nuclear fission of ^{232}Th. The third detector system was a telescope measuring 0.5- to 1.8-MeV/nucleon proton and helium nuclei and their angular distributions. A detailed analysis of electrons $\gtrsim 3$ MeV and of protons 0.5 to 1.8 MeV and $\gtrsim 35$ MeV for both the inbound and the outbound passes of the spacecraft is given. The analyses were carried out for the two different models for the Jovian magnetic field reported since the flyby of Pioneer 10, namely, the D_1 and D_2 models of Smith et al. (1974a,b). The D_2 model was used in all figures and calculations and the data were represented in terms of magnetic shell parameter L. The L dependence of fluxes of protons with energies $\cong 1$ MeV and $\gtrsim 35$ MeV and of electrons with energies $\gtrsim 3$ MeV for the region $L \lesssim 25$ is reported. Also the dependence of these fluxes on magnetic latitude is reported. Maximum fluxes are found for $\gtrsim 35$-MeV protons of $\sim 6 \times 10^6$ protons $cm^{-2}\ s^{-1}$ at $L \cong 3.4$ and for $\gtrsim 3$-MeV electrons of $\sim 2.5 \times 10^9$ el $cm^{-2}\ s^{-1}$ at $L \cong 3.1$. From the analysis conclusive evidence is found that the trapped radiation in Jupiter's inner magnetosphere is maintained and supplied by inward diffusion from the outer regions of the trapped radiation zone, that the time required for isotropization of an anisotropic flux by pitch angle scattering inside $L \cong 6$ is long in comparison with the time required for particles to diffuse inward from $L \cong 6$ to $L \cong 3$, that the high energy protons were not injected at high energies by the Crand (cosmic ray albedo neutron decay) process but were accelerated in the magnetosphere of Jupiter, and that the main conclusions of the analysis are unaffected by use of either the D_1 or the D_2 magnetic field models. Theoretical studies of the capture of trapped electrons and protons by Io were carried out, and it is found that the probability of capture by Io depends strongly upon the particle species and kinetic energy. From observations of the 0.5- to 1.8-MeV proton flux near the orbit of Io probable value is obtained for the radial diffusion coefficient of $\kappa \cong 6 \times 10^{-9}\ R_J^2\ s^{-1}$ at $L \cong 6$. This diffusion coefficient is large enough that no new sources of particles inside the orbit of Io are required to explain the existence of the high fluxes of relativistic electrons inferred to exist at $L \cong 2$ from radio observations. An unexpected result of the observations is the discovery of a decrease toward low L in the intensity of $\gtrsim 35$-MeV and 1-MeV protons inside $L \cong 3.5$, so that the maximum flux of protons observed both inbound and outbound occurred at $L \cong 3.5$. The possible causes of this effect are discussed. (auth)

1530 EVIDENCE FROM CHARGED PARTICLE STUDIES FOR THE DISTORTION OF THE JOVIAN MAGNETOSPHERE. McKibben, R. B.; Simpson, J. A. (Univ. of Chicago). J. Geophys. Res.; 79: No. 25, 3545-3549(1 Sep 1974).

The relation between the rotation of Jupiter's magnetic field and time variations in the intensity of ~6- to 30-MeV electrons observed by the University of Chicago experiment on Pioneer 10 in the outer regions of Jupiter's magnetosphere ($R \gtrsim 20\ R_J$). For $R \lesssim 40\ R_J$ observations are found to be consistent with rigid corotation of the magnetosphere with Jupiter. For $R \gtrsim 40\ R_J$, significant deviations from rigid corotation appear with the observed phase of the intensity variations leading the phase expected for rigid corotation on the inbound pass and lagging on the outbound pass. From a different point of view it is found that the time delay between the observed times of intensity minimums and the times expected on the basis of a rigid 9 hour 55 minute period for the intensity variations increased steadily while Pioneer 10 was within the magnetosphere and had reached approximately a 10-hour time difference when the spacecraft left the magnetosphere at $R \cong 98\ R_J$ outbound. The alternative hypotheses are discussed which are that in the far outer regions of Jupiter's magnetosphere ($R \cong 90\ R_J$) these deviations are the result of magnetospheric distortions arising from forces exerted by the solar wind and from drag due to lack of corotation of the magnetospheric plasma at large radial distances from the planet or that the particle intensity in the outer magnetosphere is independent of magnetic latitude and system III longitude but is a function only of time. Although the latter hypothesis is more consistent with observations of Jovian electrons in interplanetary space reported by D. L. Chenette et al. (1974), the observations inside Jupiter's magnetosphere reported seem to favor particle confinement to an extended magnetic equatorial region, significant distortions of the magnetosphere being invoked to explain the changes in phase of the intensity variations. (auth)

1531 MAGNETOSPHERE OF JUPITER AS OBSERVED WITH PIONEER 10. I. Instrument and Principal Findings. Van Allen, J. A.; Baker, D. N.; Randall, B. A.; Sentman, D. D. (Univ. of Iowa, Iowa City). J. Geophys. Res.; 79: No. 25, 3559-3577(1 Sep 1974).

The first in situ observations of energetic electrons of energy $E_e > 0.06$ MeV in the magnetosphere of Jupiter during November–December 1973 are reported. The outer magnetosphere has the form of a thin, disclike, quasi-trapping region extending from about 20 to over 100 R_J (Jovian radii). This magnetodisc is confined near the magnetic equatorial plane and has approximate axial symmetry about the magnetic axis of the planet. The observations inside a radial distance of 12 R_J are well organized by a centered dipolar model of the planet's magnetic field with a tilt of 9.5 ± 0.5° to the rotational axis and with pole at a system III longitude of 230 ± 3°. Absolute omnidirectional intensities of electrons within the stable trapping region inside 20 R_J are given for five energy ranges $E_e > 0.06$, 0.55, 5.0, 21, and 31 MeV. One example is $J(E_e > 21\ MeV) = 3.0 \times 10^5 \exp(-L/1.45)\ [(\cos^6\lambda)/$

$(4-3\cos^2\lambda)^{1/2}]^{m/2}$ for $3.5 < L < 12$ R_J, where J is in el/cm² s, L is the magnetic shell parameter in Jovian radii, and λ is the magnetic latitude. The pitch angle parameter $m = 3.5 + (3.86/L)^8$. Marked depletion of particle intensities at the orbits of Io, Europa, and Ganymede is observed in the lower energy ranges. (auth)

1532 MAGNETOSPHERE OF JUPITER AS OBSERVED WITH PIONEER 10. II. Nonrigid Rotation of the Magnetodisc. Northrop, T. G.; Goertz, C. K.; Thomsen, M. F. (Univ. of Iowa, Iowa City). J. Geophys. Res.; 79: No. 25, 3579-3582(1 Sep 1974).

The maximum count rates of energetic particles are observed earlier on the inbound pass and later on the outbound pass than one would expect if the Jovian magnetodisc moved rigidly with the planet. This lead and lag cannot be explained by the observed azimuthal distortion of the Jovian magnetic field alone. A possible explanation is that the foot of a magnetic field line in the ionosphere slips with respect to Jupiter's surface. The rate of slippage and the electric field necessary for this are estimated. The electric field may be as large as 2 V/m in the Jovian polar ionosphere. (auth)

1533 MAGNETOSPHERE OF JUPITER AS OBSERVED WITH PIONEER 10. III. Jovian Synchrotron Radiation at 10.4 cm as Deduced from Observed Electron Fluxes. Northrop, T. G. (Univ. of Iowa, Iowa City); Birmingham, T. J. J. Geophys. Res.; 79: No. 25, 3583-3587(1 Sep 1974).

Synchrotron radiation at 10.4-cm wavelength between 2.9 and 5.0 R_J (Jovian radii) was calculated from the electron fluxes observed by the Iowa Pioneer 10 detectors. This calculated emissivity (W/m³ Hz sr) exceeds the Beard and Luthey (1973) spatial resolution of the Berge (1966) interferometer measurements by about a factor of 2 at 3 R_J. The calculated emissivity is quite insensitive to the energy spectral index. It is only moderately sensitive to the equatorial angular distribution. The disagreement would be only about 30% if Beard and Luthey had used the Iowa angular distribution in their work. A factor of 2 would represent a genuine disagreement, but 30% would not exceed the combined uncertainties of this analysis and the Beard-Luthey analysis. (auth)

1534 ENERGETIC PARTICLES IN THE JOVIAN MAGNETOSPHERE. Trainor, J. H. (Goddard Space Flight Center, Greenbelt, MD); McDonald, F. B.; Teegarden, B. J.; Webber, W. R.; Roelof, E. C. J. Geophys. Res.; 79: No. 25, 3600-3613 (1 Sep 1974).

A detailed account is given of the Pioneer 10 encounter with Jupiter as viewed by the Goddard-University of New Hampshire cosmic ray experiment. Flux time histories of electrons and protons are given over a wide energy band. These show a marked variation with magnetic latitude. Significant removal of low energy protons by Io is apparent in the inner magnetosphere ($\lesssim 6$ R_J). Proton and electron energy spectra are given at various Jovicentric distances. The electron spectra are remarkably hard and constant in slope in the 0.12- to 8.0-MeV interval, the electron spectral index having a value of 1.5 to 2.0 in the region outside 25 R_J. Proton spectra are shown to transform from a power law with indices in the 3 to 4.2 range to more nearly exponential forms in the inner regions ($\lesssim 40$ R_J). Extensive data are presented on the angular distributions of protons and electrons at various locations in the Jovicentric magnetosphere. In addition, a harmonic analysis of 1- to 2-MeV proton angular distributions was performed. Simple corotation is shown to exist out to ~23 R_J. Beyond this point, other effects are contributing significantly to the particle anisotropies. Alpha/proton ratios are given as a function of Jovian radius and are compared to the earth and solar wind values. (auth)

1535 INTERPLANETARY MeV ELECTRONS OF JOVIAN ORIGIN. Teegarden, B. J. (Goddard Space Flight Center, Greenbelt, MD); McDonald, F. B.; Trainor, J. H.; Webber, W. R.; Roelof, E. C. J. Geophys. Res.; 79: No. 25, 3615-3622(1 Sep 1974).

Observations of low energy (0.2- to 8-MeV) electron increases observed in interplanetary space on Pioneer 10 as it approached within 1 AU of Jupiter were reported. These discrete bursts or increases were typically several hundred times the normal quiet time electron flux and became much more frequent as one approached Jupiter, the result being the quasi-continuous presence of large fluxes of these electrons in interplanetary space. In view of the likely origin of these electrons at Jupiter and the similarity of these increases to quiet time electron increases previously observed at earth the temporal presence of the quiet time increases was reexamined. It is found that these increases have a 13-month periodicity indicating a Jovian origin for the events near the earth as well. It is noted that the integrated flux from quiet time increase electrons at 1 AU is comparable to the integrated ambient electron flux itself. In addition, the spectra of electrons observed in Jupiter's magnetosphere, on Pioneer 10 in interplanetary space near Jupiter, for the quiet time increases near the earth, and for the ambient electron spectrum are all remarkably similar. These two lines of evidence suggest the possibility that Jupiter could be the source of most of the ambient electrons at low energies. At the same time it is difficult to understand how Jovian electrons could be distributed uniformly throughout the inner solar system so as to produce the relatively constant quiet time spectrum. At this time it is not possible to decide between a galactic knock-on origin coupled with a small residual solar modulation or a Jovian origin for the ambient electron intensity in the 0.2- to 40-MeV range. (auth)

1536 PIONEER 10 ULTRAVIOLET PHOTOMETER OBSERVATIONS AT JUPITER ENCOUNTER. Carlson, R. W.; Judge, D. L. (Univ. of California, Los Angeles). J. Geophys. Res.; 79: No. 25, 3623-3633(1 Sep 1974).

A two-channel extreme ultraviolet photometer on Pioneer 10 was used to investigate hydrogen and helium emissions from the atmosphere of Jupiter and emissions associated with the Galilean satellites. The hydrogen Lyman α signal observed from Jupiter corresponded to 400 R in brightness. By using the results of Wallace and Hunten, the eddy diffusion coefficient is found to be $K = 3 \times 10^{8\pm1}$. The He I λ584-Å emission rate was found to be 5.1 R. The radiative transfer problem for the resonantly scattered He I emissions was investigated in the coherent approximation. With these results, the observed brightness, and the derived eddy diffusion coefficient the He/H_2 ratio in the mixing region of the atmosphere was found to be $[He]/[H_2] = 0.18_{-0.12}^{+0.46}$. Emissions attributed to H I Lyman α were found at the orbital radius of Io and appear to be due to resonance scattering by a toroidal cloud of H in orbit around Jupiter. The torus is not complete, however, but extends over ~120° of the orbit, approximately centered at Io. The cloud is less than the size of Jupiter in the vertical extent, and the observed brightness indicates a total of $\sim 2 \times 10^{33}$ H atoms in the cloud. (auth)

1537 NEW MODEL FOR THE HIGH-FREQUENCY DECAMETRIC RADIATION FROM JUPITER. Scarf, F. L. (TRW Systems Group, Redondo Beach, CA). J. Geophys. Res.; 79: No. 25, 3835-3839(1 Sep 1974).

It is generally accepted that the Jupiter decametric noise bursts occur at frequencies directly related to the electron gyrofrequencies in the Jupiter ionosphere, and it is frequently suggested that the radiation occurs at the gyrofrequency. The recent Pioneer 10 measurement of a 4-G-$(R_J)^3$ dipole moment provides some basis for a more detailed analysis of the local wave mode involved in the radiation. The direct measurement of a relatively small planetary dipole moment suggests that one should consider phenomena associated with local ionospheric wave modes having frequencies higher than local gyrofrequencies for at least some of the emissions. A possible explanation for certain intense high frequency Jupiter noise bursts is discussed based on a wave-wave coupling mechanism that involves the radiation field and the $(n + \frac{1}{2})$ gyrofrequency electrostatic modes. (auth)

1538 SPIRAL INTERPLANETARY MAGNETIC FIELD: A POLARITY AND SUNSPOT CYCLE VARIATION. Svalgaard, L.; Wilcox, J. M. (Stanford Univ., CA). Science; 186: No. 4158, 51-53(4 Oct 1974).

Spacecraft observations near the earth of the average direction of the interplanetary magnetic field during the sunspot maximum year 1968 showed a deviation from the spiral field of Parker's classical description. The included angle between the average field direction when the field polarity was away from the sun and the average direction when the field polarity was toward the sun was 168°, rather than 180° as predicted by Parker. This effect appears to have a sunspot cycle variation. (auth)

1539 HYDROCARBON ABUNDANCES IN THE JOVIAN ATMOSPHERE. Strobel, D.F. (Naval Research Laboratory, Washington, D.C.). Astrophys. J. Lett. 192: No. 1, L47-L49 (15 Aug 1974).

Recent measurements of low Lα brightness imply vigorous mixing near the turbopause, approximately four orders of magnitude greater than derived for the lower stratosphere from NH_3 photochemistry and the ultraviolet albedo. Theoretical models of the hydrocarbon photochemistry in the Jovian atmosphere with a height-dependent eddy diffusion coefficient in accord with these constraints predict observable amounts of C_2H_2. Theoretical abundances are compared with observational estimates by Ridgway. (auth)

1540 SODIUM D-LINE EMISSION FROM IO: SPUTTERING AND RESONANT SCATTERING HYPOTHESIS. Matson, D.L. (National Research Council Resident Research Associate); Johnson, T.V.; Fanale, F.P. Astrophys. J. Lett. 192: No. 1, L43-L46 (15 Aug 1974).

We offer a model which explains the observations of sodium D-line emission from Io. Our model involves: (1) charged-particle sputtering

of sodium from Io's surface, (2) ejection of sodium into a cloud surrounding Io and (3) resonant scattering of incident sunlight. Observational consequences and tests of the proposed model are also discussed. (auth)

1541 PRODUCTION OF HELIUM, NEON, AND ARGON IN LUNAR MATERIAL BY SOLAR COSMIC RAY PROTONS. Walton, J. R. Houston, TX; Rice Univ. (1974). 316p. University Microfilms Order No. 74-21,347.

Thesis (Ph. D.).

To determine He, Ne, and Ar cross sections in important target elements, twelve proton (11 to 45 MeV) irradiations were performed on stacks of Mg, Al, Si, Ca, CaF_2, Ti, and stainless steel foils, at the Texas A. and M. Variable Energy Cyclotron. The inert gases produced in selected Mg, Al, Si, and CaF_2 foils were measured mass spectrometrically. Using the ^{22}Na activities measured in the Mg foils as the proton monitor, the following cross sections were determined: ^{3}He, ^{4}He, ^{20}Ne, ^{21}Ne, and ^{22}Ne in Mg, Al, and Si; ^{22}Na in Al and Si, and ^{3}He, ^{4}He, ^{36}Ar, ^{37}Ar, ^{38}Ar, ^{39}Ar, ^{40}Ar, and ^{42}Ar in CaF_2. Based on these cross sections and/or others in literature, excitation functions were constructed up to 45 and 200 MeV. With these functions, the following solar cosmic ray (SCR)-proton production rates were computed as a function of depth for isotropic incidence of two SCR-proton spectra: a) ^{3}He, ^{4}He, ^{20}Ne, ^{21}Ne, ^{22}Ne, and ^{22}Na in Mg, Al, and Si; b) ^{36}Ar, ^{37}Ar, ^{38}Ar, ^{39}Ar and ^{40}Ar in Ca; c) ^{22}Na in Na; d) ^{39}Ar in Ti; e) ^{236}U in ^{238}U; and f) ^{3}H, ^{3}He, and ^{4}He in lunar material. SCR-proton production rates of neon were calculated for Apollo 16 soil, 67701. These results, along with the inert gas measurements of size fractions and single particles of 67701, provide substantial evidence that SCR proton-produced neon is present in this soil. This is the first case of evidence for SCR-proton-produced inert gases, that is supported by accurate quantitative calculations. (Diss. Abstr. Int., B)

1542 APPLICATIONS OF A NUCLEAR TECHNIQUE FOR DEPTH-SENSITIVE HYDROGEN ANALYSIS: TRAPPED H IN LUNAR SAMPLES AND THE HYDRATION OF TERRESTRIAL OBSIDIAN. Leich, D. A. Pasadena, CA; California Inst. of Tech. (1974). 198p. University Microfilms Order No. 74-21,598.

Thesis (Ph. D.).

The resonant nuclear reaction $^{19}F(p,\alpha\gamma)^{16}O$ was used to perform depth-sensitive analyses for both fluorine and hydrogen in solid samples. The resonance at 0.83 MeV (center-of-mass) in this reaction was applied to the measurement of the distribution of trapped solar protons in lunar samples to depths of $\sim\frac{1}{2}$ μm. These results are interpreted in terms of a redistribution of the implanted H which was influenced by heavy radiation damage in the surface region. Fluorine determinations were performed in a 1-μm surface layer on lunar and meteoritic samples using the same $^{19}F(p,\alpha\gamma)^{16}O$ resonance. The measurement of H depth distributions was also used to study the hydration of terrestrial obsidian, a phenomenon of considerable archaeological interest as a means of dating obsidian artifacts. Additional applications of this type of technique are also discussed. (Diss. Abstr. Int., B)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstract 1571.

1543 (AD-775985/5) INVESTIGATION OF THE NATURE OF MAGNETIC FIELD PHENOMENA IN THE IONOSPHERE. Final report, 1 November 1970–31 July 1973. Somers, R. A. (Boston Coll., Weston, Mass. (USA). Weston Observatory). 31 Aug 1973. 21p. (AFCRL-TR-73-0596). NTIS $3.00.

The construction and testing of portions of sounding rocket payloads and the engineering services furnished for auroral zone magnetic field measurements are summarized. Operation and calibration of the component magnetic observatory and the low field coil facility required for payload design and check out are discussed. Plans for future operations and a statement of contract value are presented. (auth)

1544 (AD-776024/2) INVESTIGATION OF IONOSPHERIC CHANGES. Final report, 1 October 1971–30 September 1972. Morgan, M. G. (Dartmouth Coll., Hanover, N. H. (USA). Thayer School of Engineering). 14 Dec 1973. 24p. (AFCRL-TR-73-0764). NTIS $4.25.

A three-station ionosonde network in northern New Hampshire and Vermont was operated continuously, obtaining records every two minutes. The stations are mutually about 100 miles apart. Programs were written and brought to an operational state for reducing the film records of the ionograms by means of a Spiras-65 computer and graphacon digitizing tablet. The system is now ready for the production of iso-height contours of the true height of ionization and their intercomparison among the three stations, to develop a body of statistics on travelling ionospheric disturbances. (GRA)

1545 (AD-776025) MATHEMATICAL AND STATISTICAL ANALYSIS FOR THE REDUCTION OF IONOSPHERIC DATA AND OTHER PHYSICAL SYSTEMS. Final report, September 1972–August 1973. Friedman, M.; Miller, D. C.; Vanguri, K. S.; Gibbs, J.; Hsiung, J. H. (Arcon Corp., Wakefield, Mass. (USA)). Nov 1973. 209p. (AFCRL-TR-73-0698). NTIS $5.75.

The techniques and computer programs developed to analyze various problems are described. Most of the work involved analysis and modeling ionospheric data collected at various places around the globe. This involved correlation studies, regression analysis, fitting nonlinear time series and contour plotting. Computer programs for modeling the polar ionosphere and for updating models of ionospheric parameters with hourly measurements are developed. In addition, some efficient ray-tracing programs were prepared using accurate electron density and magnetic field models, reduced and analyzed satellite measurements of electron densities in the ionosphere, and prepared theoretical and numerical solutions of electron transport characteristics in an irradiated solid. (GRA)

1546 (AD-778649) TOPSIDE IONOSPHERE ION HEATING DUE TO ELECTROSTATIC ION CYCLOTRON TURBULENCE. Palmadesso, P. J.; Coffey, T. P.; Ossakow, S. S.; Papadopoulos, K. (Naval Research Lab., Washington, D. C. (USA)). Apr 1974. 13p. (NRL-MR-2785). NTIS $3.00.

It is shown that strong ion heating is a consequence of electrostatic ion cyclotron turbulence in the topside ionosphere. Ion temperature profiles are obtained and the implications of the heating effect on anomalous resistivity calculations are discussed. (GRA)

1547 (AD-778932) ACCESS OF SOLAR PROTONS TO THE SYNCHRONOUS ALTITUDE REGION. Report for 1 August–1 December 1973. Blake, J. B.; Martina, E. F.; Paulikas, G. A. (Aerospace Corp., El Segundo, Calif. (USA)). 15 May 1974. Contract F04701-73-C-0074. 27p. (SAMSO-TR-74-104). NTIS $3.25.

Observations of 10 to 90 MeV solar protons were made near the synchronous altitude around the time of a sudden commencement at 0037 UT on 9 August 1972 using sensors aboard 1970-93A and 1972-10A. The observations indicated that the solar protons had direct access to the synchronous altitude region through the dawn flank of the magnetosphere and were transiently trapped with an E-folding lifetime of a few drift periods. A weaker dependence of the cutoff energy upon local time was observed than was predicted by the calculations of Gall et al. (1971A, 1971B). (auth)

1548 (AD-779627) REACTION RATE DATA NO. 45. (General Electric Co., Santa Barbara, Calif. (USA). DASA Information and Analysis Center). Feb 1974. Contract DNA001-74-C-0014. 32p. NTIS $3.25.

The report contains summaries of ongoing scientific research centering around the area of atmospheric reaction kinetics. Spectra, transitions, thermochemistry, energy transfer, reactions and nuclear fireball effects are some topics included. (auth)

1549 (AD-779681) AEROSPACE CORPORATION SPACE SCIENCE PROGRAM REPORT TO COSPAR, CY 1973. Paulikas, G. A. (Aerospace Corp., El Segundo, Calif. (USA)). 25 Apr 1974. Contract F04701-73-C-0074. 27p. (SAMSO-TR-74-105). NTIS $3.25.

The results obtained during 1973 by the space research program of the Aerospace Corporation are presented. Research projects dealing with the aurora, the magnetosphere, the Earth's upper atmosphere as well as the solar corona are described. (auth)

1550 (AD-779761) MICROPULSATION OBSERVATIONS OF THE AURORAL OVAL BOUNDARY. Maple, E. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 28 Jan 1974. 35p. (AFCRL-TR-74-0054; AFCRL-ERP-463). NTIS $3.25.

At the sub-auroral-zone latitude (+54 degrees geomagnetic) of the AFCRL field station, geomagnetic micropulsations associated with the auroral oval are observed only during large nighttime disturbances. Hourly amplitudes of the horizontal component of the micropulsations in octave period bands in the 0.5 to 1024 sec period range are used as measures of the activity. Near local midnight, consistently small values are observed with local K indices ≤ 5. The southern boundary of the expanding oval approaches the station as the K index increases to 7, and large amplitudes appear. The A-O (auroral oval) micropulsations are attributed to hydromagnetic waves that propagate in the guided mode from the plasma sheet in the magnetospheric tail. The diurnal variations of the A-O amplitudes, which depend upon the micropulsation periods, are attributed to variations of the source strength in the plasma sheet. (auth)

1551 SIMULTANEOUS ELECTRIC FIELD MEASUREMENTS NEAR L = 4 FROM CONJUGATE BALLOONS AND WHISTLERS. Mozer, F. S. (Univ. of California, Berkeley); Serlin, R.; Carpenter, D. L.; Siren, J. J. Geophys. Res.; 79: No. 22, 3215-3217 (1 Aug 1974).

Electric field measurements were obtained simultaneously in conjugate ionospheres by balloons near L = 4 and near the equator by analyses of the motion of whistler ducts near L = 4 and L = 2.7. The observations were conducted from Siple, Antarctica, and Rouyn, Canada, in December 1969. The westward ionospheric electric field components measured by the two conjugate balloons are in agreement with each other, as are the westward equatorial measurements on the two ducts. The equatorial data agree in general with the mapped ionospheric results, although the equatorial measurements are smaller in average magnitude. The southward ionospheric electric field components in the conjugate ionospheres do not bear any simple resemblance to each other. (auth)

1552 ROCKET, MEASUREMENT OF WAVE NORMAL DIRECTIONS OF LOW-LATITUDE SUNSET WHISTLERS. Iwai, A.; Okada, T.; Hayakawa, M. (Nagoya Univ., Toyokawa, Japan). J. Geophys. Res.; 79: No. 25, 3870-3873(1 Sep 1974).

The measurement of the wave normal direction of short whistlers is made in the ionosphere by means of a three-dimensional crossed loop antenna on a rocket. The results of the whistler wave normal direction are presented, and some relation to the propagation characteristics in the magnetosphere and also to the penetration through the ionosphere are discussed. (auth)

1553 BEHAVIOR OF AIRGLOW UNDER THE INFLUENCE OF GRAVITY WAVES. Porter, H. S. (Univ. of Cincinnati); Silverman, S. M.; Tuan, T. F. J. Geophys. Res.; 79: No. 25, 3827-3833(1 Sep 1974).

Although the experimental observations of airglow intensity fluctuations and their possible connections with traveling ionospheric disturbances have been made by many investigators, very little attention has been given to a theoretical analysis of such ionospheric disturbances on airglow. The effect of an atmospheric gravity wave on the 6300-Å O I and the 5200-Å N I emission in mid-latitudes is specifically examined. It is also shown that for the 6300-Å O I if one assumes reasonable values for the ionospheric parameters as well as a gravity wave with a period of approximately 3 h, the resultant fluctuations in airglow are consistent with Dach's observed data as well as with the simultaneously measured variations in the ionospheric parameters. (auth)

1554 VIBRATIONALLY EXCITED NITROGEN IN STABLE AURORAL RED ARCS AND ITS EFFECT ON IONOSPHERIC RECOMBINATION. Newton, G. P. (Goddard Space Flight Center, Greenbelt, MD); Walker, J. C. G.; Meijer, P. H. E. J. Geophys. Res.; 79: No. 25, 3807-3818(1 Sep 1974).

The time-dependent continuity equations, including diffusion, were solved for the first sex energy levels of molecular nitrogen for conditions in the thermosphere corresponding to stable auroral red (SAR) arcs. The primary source of molecular nitrogen excitation was subexcitation inelastic collisions between thermal electrons and molecular nitrogen. The reaction rates for this process were derived from published cross section calculations. The loss processes for vibrational energy were quenching by electrons and atomic oxygen. The results show that molecular nitrogen is excited vibrationally to the degree that the rate constant for the ionospheric loss process, $O^+ + N_2 \rightarrow NO^+ + N$, is increased by as much as a factor of 7.6 at F_2 region altitudes. It was found that deviations from the energetically equivalent Boltzmann distribution were large, causing the rate constant to be as much as 1.6 times the rate constant calculated for the Boltzmann distribution. These results indicate that SAR arc intensities as small as 58 R can produce noticeable increases in the ionosphere ion-atom interchange reaction rate and hence in the rate of loss of ionospheric electrons. It is suggested that the observed decrease of electron density in the F_2 region in SAR arcs can probably be explained by enhanced reaction rates for ion-atom interchange between O^+ and N_2 caused by vibrational excitation of molecular nitrogen by electron impact. (auth)

1555 DAY SIDE MID-LATITUDE PLASMA TROUGH. Miller, N. (Goddard Space Flight Center, Greenbelt, MD). J. Geophys. Res.; 79: No. 25, 3795-3801(1 Sep 1974).

Above 2500 km the electrostatic probe experiment aboard the Isis 1 satellite detects a persistent day side mid-latitude plasma trough. The superposition of measurements taken over 2-week intervals at noon is used to illustrate the form and location of the quiet time trough within each season. These measurement results contrast with those observations of a less prominent day side trough at altitudes below 2500 km. Associated with the trough above 2500 km is an electron temperature maximum of ~6000°K that is sharp at midnight and broad at noon. In spring and summer a second noontime temperature maximum often appears poleward of 70° invariant latitude accompanied by an enhancement in the ionization. If the trough is viewed as a field line extension of the plasmaspheric boundary that is observed at the equator, then it is important to note the manner in which spatial and temporal characteristics of the trough differ from those of the equatorial plasmaspheric boundary. In this study an expansion in L similar to that of the equatorial plasmapause in the dusk sector is not observable in the time dependence of the high altitude trough. When it is assumed that the geophysical processes producing a plasmasphere act most directly upon the light ions, one factor contributing to the distinction between the plasma trough and the equatorial plasmapause is the increasing influence of O^+ on total plasma behavior at lower altitudes. Other factors are the local processes, such as day side F region photoionization by energetic cusp particles that produce enhancements in plasma density and electron temperature. (auth)

1556 INCOHERENT SCATTER MEASUREMENTS OF E REGION CONDUCTIVITIES AND CURRENTS IN THE AURORAL ZONE. Brekke, A.; Doupnik, J. R.; Banks, P. M. (Univ. of California, San Diego, La Jolla). J. Geophys. Res.; 79: No. 25, 3773-3790(1 Sep 1974).

Data taken by the incoherent scatter radar facility at Chatanika, Alaska, were used to investigate ionospheric conductivities and electrical currents. During quiet days the conductivities appear to vary in a way consistent with ionization arising from solar EUV radiation. At these times the ratio between the height-integrated Hall and Pedersen conductivities is close to 2. In the evening hours, enhancements in the northward electric field are found to precede small increases in the conductivities that, from analysis of electron density profiles, arise from precipitation of 3 to 10×10^8 el cm^{-2} s^{-1} sr^{-1} in the energy range 3 to 20 keV. Strong enhancements of the Hall conductivity relative to the Pedersen conductivity occur during negative bays when the electric field is in a southwestward direction. These enhancements are caused by a relatively strong flux of $1 - 3 \times 10^7$ el cm^{-2} s^{-1} sr^{-1} in the energy range 15 to 20 keV. The ionospheric currents calculated in the geomagnetic east-west direction are in good agreement with the H component measured by a nearby magnetometer; this result indicates that the current causing the ground level magnetic fluctuations is a broad horizontal sheet current. The north-south ionospheric current, however, consistently disagrees with the observed D component in a manner that cannot easily be explained unless currents parallel to the earth's magnetic field are present. The parallel currents needed in daytime, however, are directed opposite to the S_q^p current system, often inferred to explain the quiet day variations in auroral zone magnetograms. Finally, it is found that the neutral wind is of considerable importance in driving currents during quiet days in the auroral zone. Often these wind-driven currents oppose the current driven by the static electric field. (auth)

1557 AURORAL ENHANCEMENT ASSOCIATED WITH INJECTION OF BARIUM ALONG A GEOMAGNETIC FIELD LINE. Hoch, R. J. (Battelle Pacific Northwest Labs., Richland, WA); Smith, L. L.; Liemohn, H. B.; Murray, J. J. Geophys. Res.; 79: No. 25, 3859(1 Sep 1974).

Seven minutes after barium was injected along a magnetic field line from Poker Flats, Alaska, an auroral enhancement was observed moving into the field of view at Richland, Washington. The enhancement came in from the general direction of the launch site, which was far over the horizon. Auroral effects near the launch site itself would also have been far over the horizon, and so one may speculate that the effect was caused by the injection and propagated southeastward from the launch site, or one may assume that the enhancement that was observed was just a coincidence. It was suggested that it would be worthwhile to see if the effect occurs again if the experiment is repeated, and magnetospheric conditions during the event are reported in order to facilitate a future comparison. (auth)

1558 ROTATIONAL DEFORMATIONS AND RELATED DRIFT MOTIONS OF AURORAL ARCS. Oguti, T. (Tokyo Univ.). J. Geophys. Res.; 79: No. 25, 3861-3865(1 Sep 1974).

Real time TV records of aurora obtained by a highly sensitive TV camera at Syowa station in 1971 are analyzed. Motion of almost all bright auroral structures is found to have a clockwise sense of rotation (as viewed from below, in the southern hemisphere), even when a seemingly counterclockwise spiral (or fold) appears along an auroral arc. This suggests that the auroral electron precipitation is closely related to the production of negative charge excess, at least for the dusk type and high-latitude type auroras. (auth)

1559 ARTIFICIAL PRODUCTION OF TRAVELING IONOSPHERIC DISTURBANCES AND LARGE-SCALE ATMOSPHERIC MOTION. Perkins, F. W.; Francis, S. H. (Bell Telephone Labs., Whippany, NJ). J. Geophys. Res.; 79: No. 25, 3879-3881(1 Sep 1974).

The feasibility of artificial excitation of ionospheric disturbances by the free fall and explosion of rocket pay loads is examined. The energy flux so obtained is found to be comparable in intensity with the fluxes that drive natural upper-atmospheric disturbances and is estimated to be capable of exciting internal gravity waves of modest but observable amplitude. Such an experiment might also induce spread F or generate electric fields sufficient to trigger a substorm. (auth)

1560 VARIATION OF TRANSMISSION IN THE IONOSPHERE. Misra, R. (P. K. College, Midnapore, India); Chakravarty, B. Indian J. Phys.; 48: No. 5, 406-411(May 1974).

The values of non-deviative and deviative absorptions vary from region to region depending upon electron density, total particle density, and temperature of the region. Present work deals with the variation of absorption, calculated from different formulas, with altitude ranging from 60 km to 200 km, using 5 MHz wave incidents vertically, for a fixed value of $\chi(=28°)$, the solar zenith angle. The variations of absorption are presented by graphs. (auth)

1561 NEGATIVE ION EFFECT ON THE CERENKOV RADIATION FROM MAGNETOPLASMA. Agarwal, D. C. (Allahabad Univ., India). J. Inst. Eng. (India); 53: No. 6, 205-206(1973).

Power radiated by Cherenkov process from earth's ionosphere has been calculated taking into account the effects of negative ions. The calculations are made for frequencies radiated in vlf and elf banks at mid latitudes during normal days. The calculation shows that the presence of negative ions reduces the radiated power in the elf banks while it has little effect on the upper end of vlf region. (Indian Sci. Abstr.)

1562 APPLICATION TO AURORAL X-RAY SPECTROSCOPY. Saint-Marc, A. (Univ., Toulouse). Ann. Geophys.; 29: No. 4, 515-524(Oct 1973). (In French).

The calculations presented permit the study of x rays propagation through the atmosphere. This calculation which takes into account the multiple Compton and Rayleigh scattering and the photoelectric absorption is a Monte-Carlo simulation of the phenomenon. The results of the calculation show that in the case of an infinite isotropic source, the slope of the spectrum, above 50 keV remains parallel to the slope of the incident spectrum. In the case of a source with finite dimensions, a deformation of

the spectra appears when the detector is not under the source. The spectra can not be represented by a decreasing exponential. This deformation of the spectra is a function of the horizontal distance between the source and the detector. The interpretation of some observed auroral x ray spectra is attempted. (FR)

1563 INFLUENCE OF TRAVELLING IONOSPHERIC DISTURBANCES ON THE FADING STATISTICS. Pradhan, S. M.; Srivastava, S. K.; Singh, B.; Tantry, B. A. P. (Banaras Hindu Univ., India). Ann. Geophys.; 29: No. 4, 509-514(Oct 1973).

An attempt has been made to evaluate the influence of the travelling ionospheric disturbances (TID's) on different parameters characterizing fading of radio waves reflected from the ionosphere, like (i) v_T the difference between the successive amplitudes of the fading signal, (ii) the speed of fading, and (iii) the r.m.s. velocity of the randomly moving irregularities. An explanation of the Gauss distribution of v_T, observed in the case of the M-type amplitude probability distribution is also presented. (FR)

1564 DUCTING OF WHISTLERS AT LOW LATITUDES. Singh, B.; Tantry, B. A. P. (Banaras Hindu Univ., India). Ann. Geophys.; 29: No. 4, 561-568(Oct 1973).

Ducting of whistler waves at different latitudes has been studied by carrying out ray tracing computations in two different field-aligned column models one of which contained only electrons and the other contained both the electrons and ions. The results show that the enhancement factors required to trap the whistler waves in the two models are almost the same at high latitudes but differ markedly as the launching latitude decreases. At low latitudes, the enhancement required in the realistic electron-ion duct model is so high that duct propagation of whistler appears to be improbable. Hence the high whistler activity occasionally observed at low latitude ground stations may be attributed to the pro-longitudinal mode of propagation of whistler in which case the idea of ducts at low latitudes need not be evoked. (auth)

1565 CONTRIBUTION TO THE STUDY OF EXCITATION MECHANISMS IN POLAR AURORAE. Gerard, J. C. Liege; Univ. Liege (1974). 243p. (In French).

Thesis.

An attempt was made to clarify certain points relative to excitation phenomena in aurorae. The means used were spectroscopy and photometry at ground level and in rockets. Results obtained by other techniques were used however when necessary. The auroral morphology and the principal excitation mechanisms were reviewed. All the known processes leading to the emission of visible, uv, and ir lights beginning with auroral precipitations are examined. (tr-auth)

1566 ELECTRIC FIELD MICROSTRUCTURES IN THE AURORAL E REGION. Holtet, J. A. (Norske Institutt for Kosmisk Fysikk, Oslo). Geophys. Norv.; 30: No. 4, 1-88(1973).

Microstructures in the auroral E-region were studied on the basis of in situ observations of ac electric fields. The main characteristics of the observed wavefields, called ELF E-layer noise, are described. The emissions appear in the altitude region of 95 to 120 km, and the noise is found in the range of 50 Hz to 3 kHz. The orientation in space of the wave E-field vector is well defined and is approximately in the magnetic east-west direction. This does, however, change significantly with altitude. The wave is electrostatic. It is shown that these fields can be generated by a two-stream plasma instability. The observed characteristics are compared with features derived using linear instability theory and an ionospheric model representing the observation conditions, and a good correspondence is found. (IAA)

1567 DETERMINATION OF D-REGION ELECTRON LOSS RATES FROM VLF MEASUREMENTS DURING SID EVENTS. Bjontegaard, G. (Norske Institutt for Kosmisk Fysikk, Oslo). Geophys. Norv.; 30: No. 5, 31-60(1973).

X-ray fluxes in the wavelength bands of 0.5 to 3 and 1 to 8 A, measured in the spaceprobe Solrad 9, are used to calculate electron production in the lower ionosphere during solar flare events. Models for calculating the resulting vlf phase and amplitude changes are developed. This is done both for propagation over long paths (above 4000 km) where a fast procedure for solving the mode equation is worked out, and for paths shorter than 500 km where geometrical optics with two hops are used to describe the propagation. Six flare events are studied: three where vlf recordings were made over long, mid-latitude paths, and three events over a short, high latitude path. By comparing calculated and measured vlf phase and amplitude, quiet electron density profiles, effective recombination coefficients, and effective attachment-detachment coefficients are deduced. (IAA)

1568 APPLICATION OF PLASMA KINETIC THEORY TO AURORAL BIRKELAND CURRENTS. Lin, C. A. Houston, TX; Rice Univ. (1974). 211p. University Microfilms Order No. 74-21,299.

Thesis (Ph. D.).

The theory of plasma instability near the plasma frequency is applied to explain certain high frequency modulations observed in an aurora arc. The observations were made with a sounding rocket payload built at Rice University. It was designed to investigate the relation between Birkeland currents associated with an auroral arc and energetic particles. High frequency modulations in fluxes of kilovolt electrons were observed by the Rice group. Comparison with data from the Chatanika radar indicates that these modulations were close to the local plasma frequency. It appears that the observed oscillations can be interpreted in a consistent way as the non-linear development of a classical gentle-bump instability. The reduced (parallel) distribution functions $F_0(v_{\parallel})$ are determined from the differential fluxes j measured by channeltron particle detectors. Two approaches to computing the growth rates are presented. One is the least-squares-fit formula approach, which cuts off sharp bumps in data. This provides information on the general shape of F_0 at many times but is not good on fine structure. Reverse slopes in these "smoothed" F_0 can indicate a positive contribution to the growth rate, but are not sufficient to overcome collisional damping. Another approach is to analyze the detailed unsmoothed data. Abrupt changes in measured fluxes with pitch angle can cause reverse slopes in F_0, sufficiently large to overcome collisional damping. There are about seven time intervals between flight times T + 210 and 260 that satisfy the following two conditions: maximum computed net growth rate, including collisions, is greater than zero, and the reverse slope of F_0 persists for at least three spin periods. These seven time intervals are considered as the ones in which the gentle-bump instability is theoretically most likely; two of these (T + 211 with $E_{\parallel}$ = 0.4 keV and T + 216 with $E_{\parallel}$ = 5.6 keV) correspond with observed fluctuations. The other five time intervals can presumably be interpreted as instances where the wave amplitude has not yet reached the rather high detection threshold, or the detector is not oriented in a suitable direction to observe the maximum modulation. And it is found that absolute instability will occur (i.e., the wave will grow in time locally without propagating) at 211 and 216, provided that $\partial F_0/\partial v_{\parallel}$ is sufficiently high or the half width of the relevant bump is sufficiently small. This instability should produce high frequency oscillations in fluxes of kilovolt electrons as well as in the related electric field. (Diss. Abstr. Int., B)

1569 MODEL CURRENT SYSTEM ASSOCIATED WITH MULTIPLE AURORAL ARCS. Sesiano, J. Houston, TX; Rice Univ. 1974. 192p. University Microfilms Order No. 74-21,330.

Thesis (Ph. D.).

A rocket-borne experiment comprising a vector magnetometer and an array of particle detectors to study the currents and precipitating particles associated with multiple auroral arcs was conducted at Poker Flats, Alaska, on February 2, 1972 at 01:22^h local time. The magnetometer measured the magnetic field as the payload passed over the arc system (visual intensity about 20 kR). From the changes in the magnitude and direction of the field, it was possible to build a system of electrojets and Birkeland (field-aligned) currents. Two models were compatible with the data. The first model consisted of four pairs of current sheets, three of them corresponding to visible arcs, aligned in a magnetic east-west direction, of current densities ~30/μA m^2; two eastward and one westward electrojet of current magnitude between 1000 and 2000 amperes were also present. They were generally located under the regions of precipitating electrons. The second model is similar to the first one, but two of the current sheets were replaced by a broader one; it is thus a model consisting of three pairs of current sheets. Unfortunately, no particle data were obtained due to an instrumental failure. (Diss. Abstr. Int., B)

Magnetospheric Phenomena

Refer also to abstracts 1549 and 1552.

1570 (AD-777870) ANALYSIS OF ELECTRON DATA FROM THE OV1-13 SATELLITE. Final report, 1 July 1972–31 December 1973. Klumpar, D. L.; Webber, W. R.; Lockwood, J. A. (New Hampshire Univ., Durham (USA). Dept. of Physics). 25 Jan 1974. Contract F19628-73-C-0009. 23p. (AFCRL-TR-74-0136). NTIS $3.00.

Some gross features in the radiation belts have been investigated with the E-MA electron detector (nominal energy range 0.1 MeV to 1.0 MeV) on the OV1-13. More detailed and comprehensive studies cannot be made because there is too little data coverage. Temporal

variations were observed in the spectral shape and intensity as a function of L during the June 10, 1968, geomagnetic storm. Comparisons were made of the particle populations measured by the OV1-13 E-MA detector and by the ATS-1 experiment ($50 < E < 500$ keV) during the substorm on April 10, 1968, and some later periods near June, 1968. (auth)

1571 (AD-778069) ATLAS OF THE MIDLATITUDE F-REGION RESPONSE TO GEOMAGNETIC STORMS. Air Force surveys in geophysics. Mendillo, M.; Klobuchar, J. A. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 6 Feb 1974. 268p. (AFCRL-TR-74-0065; AFCRL-AFSIG-281). NTIS $6.50.

The ionospheric response to 75 geomagnetic storms has been examined using total electron content (TEC) data obtained at Hamilton, Massachusetts (42.6N, 70.8W). Simultaneous measurements of the F2-region critical frequency (N(MAX)) and equivalent slab thickness (TAU = TEC/N(MAX)) to be monitored during the same events. Both graphical and tabulated formats were used to present the response of the parameters for five days of each storm period. This broad data base should provide a unique source for examining the variety of possible storm effects, for testing storm models, and for comparison with the storm effects observed at other locations. (auth)

1572 DAILY AND SEASONAL VARIATIONS OF FREQUENCY OF APPEARANCE OF SUDDEN COMMENCEMENTS (SC) AND SUDDEN IMPULSES (SI). Nesmyanovich, E. I. Kosm. Issled. Ukr.; No. 3, 37-40(1973). (In Russian).

Worldwide data were collected from Jan. 1, 1955 to Dec. 31, 1968 on 894 cases of SC and 2152 cases of SI and used in the study of daily and seasonal variations of the frequency of their appearance. The daily variations of all events showed a maximum at (06 to 8) hr UT. In the same period the daily variation was more strongly shown. There was no seasonal variation in the frequency of appearance of SC and SI. Thus, geomagnetic disturbances, both SC and SI, are controlled by world time. The results indicate that the presence or absence of SC and SI in geomagnetic storms is determined not only by the nature of the corpuscular current but also by the presence of pulsating waves and tangential explosions but also by purely terrestrial conditions. (tr-auth)

1573 LOW-LATITUDE CUTOFF FOR WHISTLERS OBSERVED ON THE GROUND. Rao, M. (Space Science and Tech. Centre, Trivandrum, India); Somayajulu, V. V.; Dikshit, S. K.; Tantry, B. A. P. J. Geophys. Res.; 79: No. 25, 3867-3869(1 Sep 1974).

Ground observations of whistlers were analyzed to yield a low latitude cutoff around 16° geomagnetic latitude. It is suggested that this cutoff signifies a latitude below which, irrespective of the magnetic activity, no whistlers can be heard or when a few are heard, they can readily be identified as originating at higher latitudes. (auth)

1574 QUANTITATIVE MODEL OF THE MAGNETOSPHERIC MAGNETIC FIELD. Olson, W. P.; Pfitzer, K. A. (McDonnell Douglas Astronautics Co., Huntington Beach, CA). J. Geophys. Res.; 79: No. 25, 3739-3748(1 Sep 1974).

Quantitative representations of the magnetic field associated with the magnetopause currents and the distributed currents (tail and quiet time ring currents) were developed. These fields are used together with a dipole representation of the main field of the earth to model the total vector magnetospheric magnetic field. The model is based on quiet time data averaged over all "tilt angle" values. The weak field in the equatorial region of the inner magnetosphere and the tail field structure is included in the model. The depressed field region in the inner magnetosphere is especially important for the accurate modeling of several observed particle and magnetic field phenomena. The field representation is analytic and is given in Cartesian coordinates with power series and exponential terms. It is valid from the subsolar magnetosphere to beyond lunar orbit. This series expansion allows the magnetic field to be modeled accurately over an extended region of the magnetosphere and permits the representation of the field in the same region as that of its source currents. The model has been tested by using it to calculate several observed magnetospheric particle and field properties. The latitude cutoffs for solar cosmic rays and the trapping boundary of low energy particles computed from the model agree well with observations. Model calculations also yield field line shapes in agreement with barium cloud observations. A simplified version of the model that can be used out past geosynchronous orbit is also presented. (auth)

1575 CYCLOTRON RESONANCE AMPLIFICATION OF WHISTLERS: LASER INTERPRETATION AND ANALYSIS. Altshuler, S. (Univ. of Colorado, Boulder). J. Geophys. Res.; 79: No. 25, 3791-3794(1 Sep 1974).

The interaction of VLF whistler radiation with trapped (Van Allen) electrons is analyzed in terms of absorption and stimulated emission transitions at the Doppler-shifted cyclotron resonance. The transitions occur between energy states of the spiraling and high energy electrons, and the deduction proceeds in the same manner as when the gain of a laser is computed. The result is substantially identical to that derived classically by solving the linearized Vlasov-Maxwell equations. (auth)

1576 RADIATION PRODUCTION AND ENERGY DEPOSITION BY RING CURRENT PROTONS DISSIPATED BY THE CHARGE-EXCHANGE MECHANISM. Proelss, G. W. (Univ., Bonn). Ann. Geophys.; 29: No. 4, 503-508(Oct 1973).

This study investigates the charge-exchange mechanism by which part of the energy contained in the magnetic storm ring current is injected into the low-latitude upper atmosphere. The resulting radiation production and energy deposition is estimated. In connection with nightglow observations, these results could be used to assess the importance of the charge-exchange mechanism as a loss process for ring current energy. (FR)

1577 OBSERVATIONS OF MAGNETOSHEATH PLASMA AT THE LUNAR ORBIT. Fenner, M. A. Houston, TX; Rice Univ. (1974). 239p. University Microfilms Order No. 74-21,267.

Thesis (Ph. D.).

The observations of magnetosheath plasma from a lunar-based (60 R_e) experiment (SIDE) are presented. Ten months of data are compiled to define the general sheath structure. Plasma parameters of pressure and temperature follow the predictions of laminar flow. "Turbulence," indicated by the diffusion of particles into a high energy tail, is observed to increase near the bow shock in the dusk sheath. This result confirms the presence of particle interactions with the waves that were reported to be a maximum at the bow shock. Turbulence in the dusk sheath is observed to correlate with geomagnetic activity. The dawn sheath shows no such correlation. The ordered structure of the dusk parameters and the correlation with Kp indicate an asymmetry of the two sides of the magnetosheath. Such an asymmetry has been observed before in the shock structure, and boundary motions, but not in plasma data. Magnetosheath-like spectra are observed just inside the magnetopause and farther out in the tail. These low energy ions (≤100 eV) are identified as the magnetotail boundary layer. They are observed to monotonically increase in energy at the magnetopause. These ions in the tail indicate direct access of interplanetary particles through the magnetosheath to the earth's magnetosphere. (Diss. Abstr. Int., B)

1578 PLASMA DEPLETION NEAR A MAGNETOSPHERIC BOUNDARY. Zwan, B. J. Houston, TX; Rice Univ. (1974). 186p. University Microfilms Order No. 74-21,351.

Thesis (Ph. D.).

A mathematical model is presented which describes the process whereby plasma is "squeezed out" along interplanetary field lines resident in the region between the shock and the effective obstacle of a planetary body. The net effect of this squeezing process is to leave a region shockward of the magnetospheric boundary depleted of plasma. Such a region is called a depletion layer. Numerical solutions are obtained for the dimensionless magnetohydrodynamic conservation equations describing this process. It is shown that the solutions depend only on the dimensionless parameter ξ, which is the ratio of the initial magnetic pressure to the total external pressure measured just post shock. Previous work on this problem is extended by including into the analysis, flux tube curvature which gives the plasma an initial acceleration out along field lines. Also bow shock curvature is included which also accelerates plasma out along field lines and in addition accelerates the flux tube essentially parallel to the magnetopause boundary. The acceleration of plasma out along field lines will increase layer thickness while flux tube acceleration parallel to the magnetopause will decrease the thicknesses. It is shown that inclusion of magnetic tension into the analysis, which also tends to accelerate a given flux tube essentially parallel to the boundary, can reduce the layer thicknesses by as much as a factor of 2. It is shown that cross-field diffusion does not significantly inflate the depletion layers. The solutions indicate that a given depletion layer will have the same thickness all along the magnetopause boundary, and the layer thicknesses will increase as the solar wind Alfvén Mach number decreases, and they increase approximately linearly with increasing ξ. The results give thinner depletion layers than Lees' axisymmetric model. For the earth's magnetosphere with $M_A(SW) \approx 8$, the new calculations indicate that a depletion layer whose density has been depleted by a factor of two should be ≈ 750 to 1500 km thick. Straightforward extension of the depletion layer analysis to Mars and Venus indicates that these planets should have layers

~1/15, ~1/10 as thick as the Earth, although diffusion and ionospheric effects may obliterate the Martian and Cytherean depletion layers. (Diss. Abstr. Int., B)

1579 INFLUENCE OF THE VARIANCE OF THE INTERPLANETARY MAGNETIC FIELD ON GEOMAGNETIC ACTIVITY. Garrett, H. B. Houston, TX; Rice Univ. (1974). 144p. University Microfilms Order No. 74-21,273.

Thesis (Ph. D.).

Hourly values of several solar wind and interplanetary magnetic field (IMF) parameters are compared to the AE and ap geomagnetic indices. It is found that the average value of the southward component of the IMF correlates the best with hourly values of AE and (smoothed) values of the three hour ap index. Improvement in these correlations (about 5 per cent) was effected by multiplying the southward component by the bulk velocity of the solar wind (the resulting quantity is proportional to the dawn to dusk electric field generated by the solar wind plasma as it moves past the earth). Further improvement (another 5 per cent) was accomplished by introducing the variance of the IMF. This result indicated that the solar wind could merge or transfer energy more efficiently to the magnetosphere when the IMF (or equivalently, the interplanetary electric field) was fluctuating in a frequency range from 5 minutes to an hour. Finally, a possible source of the IMF variance, $\rho V\, DV/Dt$ (where ρ is the solar wind density, V the solar wind bulk velocity, and DV/Dt the time derivative of V), is discussed. These observations may make possible the accurate forecasting of geomagnetic activity as measured by AE or ap. (Diss. Abstr. Int., B)

PHYSICS (ATOMIC AND MOLECULAR)

1580 (AD-778377) REACTION RATE DATA NO. 44. Resume of FY 74 DNA-Sponsored Chemistry/Physics Reaction Rate Research Programs. (General Electric Co., Santa Barbara, Calif. (USA). DASA Information and Analysis Center). Jan 1974. Contract DNA001-74-C-0014. 33p. NTIS $3.25.

The issue of the Dasiac reaction rate data presents brief resumes of DNA-sponsored chemistry/physics reaction rate research programs for FY 1974. Topics discussed include the following: weapons phenomenology in the containment zone; reaction rates critical to propagation; theoretical studies of ionizing mechanisms in the upper atmosphere; determination of reaction rates and ionizing mechanisms by use of natural disturbances; atomic and molecular physics of ir emissions; ir phenomenology and code development; atomic and molecular physics of ir emissions; and, ir phenomenology and optical code development; ir phenomenology and optical code data base. (auth)

Beams and Their Reactions

Refer also to abstracts 228 and 1634.

1581 (AD-778965) POLARIZED ELECTRON SOURCES AND SCATTERING EXPERIMENTS. Final Report, 1 December 1968–30 November 1973. Bederson, B. (New York Univ., N. Y. (USA). Dept. of Physics). 25 Mar 1974. 43p. (AFOSR-TR-74-0755). NTIS $3.25.

Research on polarized electron beam scattering, especially as scattered by polarized alkali atom beams is briefly discussed. Publications and conference papers are listed. Also included is a review entitled "Electronic Polarization Behavior in Collisions." Electron alkali collisions are the main topic discussed. Differential cross sections for total scattering, elastic scattering, spin exchange, backward scattering, resonance transitions, and excitation are treated. (auth)

1582 (AD-779696) MODULATION OF AN ELECTRON BEAM AT OPTICAL FREQUENCIES. Final Scientific Report. Bergstein, L. (Polytechnic Inst. of Brooklyn, N. Y. (USA)). 1 Apr 1973. 23p. NTIS $4.25.

Attempts to reproduce as closely as possible the observation of Professor Schwartz that electrons, after interacting with an intense laser beam in a thin transparent film, gave off light when they struck a nonfluorescent screen. An electron beam (of approximately 40,000 electron-volts) and a pulsed laser beam (of 40 watts peak power) were made to intersect at right angles in (1,000 Å) thin transparent films of amorphous quartz (SiO_2), polycrystalline sapphire (Al_2O_3), and monocrystalline mica. Light given off when the transmitted electron beam struck a nonfluorescent alumina target was searched for with a sensitive photomultiplier capable of detecting single photons. No light that could be attributed to modulation of the electrons was detected. Further experimental work was devoted to modulating an electron beam with light and electronic detection of the modulation. This approach was an attempt to separate the original experiment in two parts: the results of this experiment were also negative. (auth)

1583 (KHFTI-73-13, pp 82-90) NONLINEAR THEORY OF ELECTRON BEAM INTERACTION WITH SLOW ELECTROMAGNETIC WAVES. Shcherbinin, G. P.; Khizhnyak, N. A. 1973. (In Russian).

The possibility of the analytical construction of a precise nonlinear method for the solution of the problems of the interaction of electron beams with slow electromagnetic waves is discussed. The reasons that this solution could not be obtained earlier are considered. (tr-auth)

1584 (KHFTI-73-13, pp 91-97) RESONANCE EFFECTS IN SPATIALLY MODULATED BEAMS. Repalov, N. S.; Tyrnov, V. F. 1973. (In Russian).

A kinetic theory is proposed for the parametric instabilities in modulated charged particle beams for any direction of the propagation of the wave participating in interactions without assumptions on their potential. (tr-auth)

1585 (KHFTI-73-13, pp 98-101) NOISE EFFECT ON THE DISTRIBUTION FUNCTION OF A MODULATED ELECTRON BEAM. Aseev, G. G.; Kuznetsova, G. G.; Repalov, N. S. 1973. (In Russian).

A method for the experimental study of the effect of noise spontaneously excited in the system and its amplification on the distribution function of the electrons of a beam is described and the results are reported. The results of the measurement of the dependence of the electron distribution function on the different beam parameters, particularly the beam current, and on the modulating fields are discussed. The form of the distribution function and the noise spectrum was shown. (INIS)

1586 (KHFTI-73-13, pp 102-107) THEORY OF THE PARAMETRIC INSTABILITY OF THE ELECTRON BEAM IN THE MAGNETIC FIELD. Pasynok, A. I.; Repalov, N. S. 1973. (In Russian).

The parametric instability of the electron beam in a magnetic field was studied. The equation of the electric field in a cylindrical modulated beam was introduced. The resonance conditions and the fields in electron beams completely filling the waveguide were examined. The studies showed that in a limited modulated electron beam moving in a homogeneous magnetic field, effective interaction between the branches of oscillations existing at resonance occurs. Analysis of the resonance conditions indicated that the instability studied can occur in rather wide frequency ranges. (INIS)

1587 SPACE DISTRIBUTION OF REFLECTED AND ABSORBED ELECTRONS. Golovyashkina, L. V.; Kosarev, Yu. G.; Nakhodkin, N. G. Vychisl. Sist.; No. 56, 130-135(1973). (In Russian).

This study presents the results on the spatial distribution of reflected and adsorbed electrons for Be, Al, Pb at incident beam angles $\theta = 60$ and 80° and energy $E_0 = 2$ to 20 keV. 3 refs. 4 figs. (SJR)

1588 DETERMINATION OF THE OPTIMAL PROFILE FOR AN AXISYMMETRIC OUTLET OPENING OF A PLASMA ION SOURCE. Akin'shin, L. I.; Chuyan, R. K. Izv. Vyssh. Ucheb. Zaved., Aviats. Tekh.; No. 4, 68-74(1973). (In Russian).

A procedure is given for computing the losses in neutral atoms of an operating field in a plasma ion source as a function of the shape of the outlet opening. An algorithm is developed for finding the optimal shape of the outlet opening, and the results of the numerical solution are described using an electronic digital computer for the case of an axisymmetric outlet opening. The purpose of the investigation is to analyze the chances for increasing gas savings in the plasma ion source. Two illustrations, two tables, and three bibliographic references are included. (JPRS)

1589 THE THEORETICAL AND EXPERIMENTAL STUDY OF THE IONIZATION PROCESSES DURING THE LOW ENERGY ION SPUTTERING. Sroubek, Z. (Ceskoslovenska Akademie Ved., Prague). Surface Sci.; 44: No. 1, 47-59(Jul 1974).

The process by which atoms are ionized as they are sputtered from a metal surface has been analyzed both theoretically and experimentally. In the theoretical part the expressions for ionization coefficient R^+ of the atoms having ionization energy much larger than the metal work function have been derived using a molecular orbital method. The effect of the level crossing was estimated in an approximate way. In the experimental part the SIMS experiments on clean Ni and Al surfaces and on Ni surfaces covered with a submonolayer of adsorbed K, Na and Al are reported. It has been found and it is for the first time reported that the energy distribution of ions sputtered from a submonolayer of adatoms is independent of energy (200-2500 eV) and mass (Ar^+, Xe^+) of incident ions and depends only upon the adsorption energy of the adatom. The energy distribution of ions sputtered from bulk samples has been found dependent on the primary ion energy. The measurement of the absolute value of R^+ has shown that there is a strong correlation between the number of the adatom valence d-electrons and the value of R^+, the value of R^+ being smaller for atoms with more d-electrons. These experimental data have been compared with the theoretical expressions and the important role of the mechanism which takes into account the bending of the adatom energy level has been assessed. (auth)

1590 THE MECHANISM OF SIMULTANEOUS IMPLANTATION AND SPUTTERING BY HIGH ENERGY OXYGEN IONS DURING SECONDARY ION MASS SPECTROMETRY (SIMS) ANALYSIS. Tsai, J. C. C.; Morabito, J. M. (Bell Telephone Labs., Inc., Allentown, Pa. (USA)). Surface Sci.; 44: No. 1, 247-252 (Jul 1974).

Two anomalous surface effects occurring in SIMS analysis which are due to an enhancement of the secondary ion yield via reacted oxygen over the first few hundred angstroms of depth have been observed. The first effect is a secondary ion yield enhancement due to the presence of surface oxide. A theoretical expression of the implanted oxygen distribution in the sample as a function of measurement time, hence, depth is presented. (auth)

1591 PRODUCTION OF NEGATIVE IONS AND GENERATION OF INTENSE NEUTRAL BEAMS BY LASER IRRADIATION. Wong, A.Y.; Dawson, J.M.; Gekelman, W.; Lucky, Z. (Department of Physics, University of California, Los Angeles, California 90024). Appl. Phys. Lett. 25: No. 10, 579-580 (15 Nov 1974).

10 A of H^- ion current is produced by a CO_2 laser on NaH targets. A scheme of resonant detachment of electrons from negative ions by the laser is also discussed. (auth)

Atomic and Molecular Properties

Refer also to abstracts 149, 153, 1633, 1659–1662, 2168, and 2652.

1592 (AD-777213) RESONANCE SCATTERING OF LYMAN-ALPHA RADIATION BY HYDROGEN IN THE GROUND STATE. Moses, H. B. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 6 Dec 1973. 35p. (AFCRL-TR-73-0744; AFCRL-PSRP-578). NTIS $3.25.

The cross section for the resonance scattering of Lyman-alpha radiation by spinless, nonrelativistic hydrogen atoms in the ground state is calculated using a two-level model. A slight generalization of Dirac'c resonance scattering theory is used (to take into account the degeneracy of the upper state) together with the exact matrix elements for the electromagnetic interaction. The shift in position of resonance is finite. The differential cross section is given as a function of the scattering angle for both polarized and unpolarized radiation. The total cross section is shown to be equal to that obtained by detailed balancing using the Einstein A and B coefficients. Finally, the radiation pattern of the scattered radiation is found. (auth)

1593 (ANL-8096, pp 127-130) ATOMIC SPECTROSCOPY. Apr 1974.

In Chemistry Division annual report, July 1972–June 1973.

The ground-state electron configuration of neutral Np was identified by analysis of the spectrum. Nuclear moments of ^{237}Np computed from various levels are reported. Relative oscillator strengths of about 150 Sc I transitions were measured using a high-temperature version of the heat-pipe oven previously developed at ANL. (JGB)

1594 L-SHELL PHOTOELECTRIC CROSS-SECTIONS OF GAMMA RAYS. Sivasankara Rao, K.; Arunaprasad, G.; Parthasaradhi, K. (Univ., Andhra, Waltair, India). J. Mines, Metals Fuels; 21: No. 5, 153; 161(1973).

L-shell photoelectric cross sections are estimated in the elements W, Au, Pb, and U in the energy region 25 to 110 keV, and a comparison is made with the theoretical values of Schmickley and Pratt. (Indian Sci. Abstr.)

1595 CALCULATING CHARGE DISTRIBUTION OF IONS FORMED DURING IONIZATION OF INNER ATOMIC SHELLS. Kalanov, T. Z.; Parilis, E. S. (Inst. of Electronics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 3, 81-85 (1974). (In Russian).

In this study, calculations are made on the charge distributions of neon and argon ions formed as a result of Auger and radiation transitions, and also as a result of vibration, after ionization of inner atomic shells. The results of the calculations are compared with experimental data. (SJR)

1596 SECOND-ORDER OPTICAL PROPERTIES AND VAN DER WAALS COEFFICIENTS OF ATOMS AND MOLECULES IN THE RANDOM PHASE APPROXIMATION. Martin, P. H. S. (California Inst. of Tech., Pasadena (USA). Arthur A. Noyes Lab. of Chemical Physics); Henneker, W. H.; McKoy, V. (Paris-11 Univ., 91 – Orsay (France)). Chem. Phys. Lett.; 27: No. 1, 52-56(1 Jul 1974).

An RPA calculation and a direct sum over states are used to calculate second-order optical properties and van der Waals coefficients. A basis set expansion technique is used and no continuum-like functions are included in the basis. However, unlike other methods the basis functions are not forced to satisfy any sum-rule constraints, but rather the formalism (RPA) is such that the Thomas–Reiche–Kuhn sum rule is satisfied exactly. Central attention is paid to the dynamic polarizability, from which most of the other properties are derived. Sample results are shown for helium and molecular hydrogen. Agreement with experiment and other theoretical approaches is good, and the practicality of the method suggests its application to larger molecular systems and other properties. (auth)

1597 MOLECULAR EFFECTS IN FIELD IONIZATION OF H_2. Hanson, G. R.; Humes, G. E.; Inghram, M. G. (Chicago Univ., Ill. (USA). Dept. of Physics). Chem. Phys. Lett.; 27: No. 4, 479-483(15 Aug 1974).

New structure in the energy distribution of H^+ produced by field ionization of HD is reported. The structure is shown to result from a field-induced pendulum type of motion of HD^+ before it dissociates. Effects of associated pair field ionization are discussed. (auth)

1598 PROPERTIES OF THE H-REGULAR WAVE FUNCTIONS OF THE HELIUM ATOM. Reshetnyak, V. I.; Fedorov, F. I. (Inst. of Physics, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 4, 51-56 (1974). (In Russian).

Consideration is given to regular, test wave functions of the ground state of the helium atom, which satisfy the requirement of regularity as a result of applying an energy operator to the function (H-regular functions). By means of the simplest functions, calculations were made on the mathematical expectations of the operators $1/r_1$, $\delta(r_1)$, $\delta(r_{12})$, u and 1/u. Calculations were also made on the distribution function f(u) and Coulombic well $\Delta(u)$. A comparison with analogous calculations of other authors is presented. (16 refs, 2 tables, 3 figs.) (SJR)

1599 LONGITUDINAL RELAXATION TIME MEASUREMENTS IN HYDROGEN GAS AT LOW DENSITIES. Kisman, K. E.; Armstrong, R. L. (Univ. of Toronto). Can. J. Phys.; 52: No. 16, 1555-1566(15 Aug 1974).

Measurements of the nuclear spin longitudinal relaxation time through the region of the characteristic minimum at 49.0 MHz in molecular hydrogen are reported at 77.5, 296, and 385K. At 77 K molecular hydrogen may be treated as a single J-level quantum system. The experimental measurements serve to check the basic approximations in the Bloom-Oppenheim relaxation theory. The present data show that the ratio τ_{sr}/τ_d of the correlation times associated with the spin-rotation and dipolar interactions lies in the range from 0.58 to 0.83; the theoretical prediction is 0.6. At 296 and 385K molecular hydrogen may be treated as a two J-level quantum system. Starting from the Bloom-Oppenheim theory it is possible to express the contribution to the transition rate from collisions which cause transitions between the J states to that which causes transitions within a J manifold in terms of a parameter R. The present experiments are consistent with R values in the ranges $1 < R < 10$ at 296K and $0.6 < R < 20$ at 385K. (auth)

1600 ACCOUNTING FOR MASS VARIATION IN TERMS OF VELOCITY IN QUANTUM MECHANICS. Ionescu-Pallas, N. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 25: No. 10, 1141-1146 (1973). (In Rumanian).

The relativistic quantum problem of the motion of a point-like particle in a central field is investigated by a new procedure. One proceeds with a Hamilton operator which avoids the negative energy states and disregards the spin. The wave equation—which has an infinite differential order—is exactly solved in the case of the S-states of a hydrogen atom. For a general electromagnetic field the conditions are established for acquiring the Lorentz covariance. (auth)

1601 VACUUM POLARIZATION IN HEAVY–ION COLLISIONS. Gyulassy, M. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. Lett. 33: No. 15, 921-925 (7 Oct 1974).

The results of a study on vacuum polarization, orders $\alpha\ (Z\alpha)^n$, $n \geq 3$, for large–Z systems encountered in heavy–ion collisions are presented. It is shown that the higher–order vacuum polarization cannot prevent the $1S_{1/2}$ state from reaching the lower continuum, $E = -m_e C^2$, for some critical charge $Z_{cr} \sim 170$. In addition, the stability and localization of a heliumlike system for $Z > Z_{cr}$ is demonstrated. (auth)

1602 RADIATIVE CORRECTIONS TO RELATIVISTIC MAGNETIC–DIPOLE DECAYS OF HYDROGENLIKE IONS. Lin, D.L. (Physics Department, Columbia University, New York, New York 10027); Feinberg, G. Phys. Rev. A 10: No. 4, 1425-1429 (Oct 1974).

The radiative correction to the decay $2S_{1/2} \rightarrow 1S_{1/2} + 1\gamma$ in hydrogenlike atoms is calculated to relative order α. All terms of order $\alpha \ln\alpha$ and α are found to cancel. The cancellation of the order–α terms does not occur in other relativistic Ml transitions in hydrogenlike atoms. (auth)

1603 TRANSIENT QUANTUM EFFECT. Gudder, S. (Univ. of Denver). Found. Phys.; 4: No. 3, 413-416(Sep 1974).

A transient quantum effect is shown to occur for a superposition of stationary states. An alternative to Schroedinger's equation is considered which predicts a transient effect even for energy eigenstates. (auth)

1604 MULTIPHOTON TRANSITIONS IN HELIUM ATOMS IN INTENSE ELECTROMAGNETIC FIELD. Thareja, R. K. (Delhi Univ. (India). Dept. of Physics and Astrophysics). Phys. Lett., A; 49: No. 1, 54-56(12 Aug 1974).

The T-matrix for the interaction of intense electromagnetic field with helium-like atoms is obtained using a time-dependent

unitarity transformation. Essentially the transformation acts as a space transition operation. (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstract 1836.

1605 (AED-CONF-74-089-009) POSITRON ANNIHILATION IN TELLURIUM AND SILICON. Dietrich, K.; Siethoff, H.; Landwehr, G. (Wuerzburg Univ. (F. R. Germany). Physikalisches Inst.). 1974. 11p. (In German). (CONF-740451-18). INIS.

From conference on solid state physics; Freudenstadt, F. R. Germany (1 Apr 1974).

6 figs.; 2 refs. Available from the ZAED.

Measurements of the positron lifetime in doped and pure semiconductors (tellurium, silicon) were performed in order to study the influence of defects on the positron lifetimes. The centers of disturbance are antimony for Te and phosphorus for Si. The time spectrum of positron annihilation, the dependence of the second component of lifetime in Te-monocrystals upon the Sb defect concentration, in Si-monocrystals upon the P defect concentration, the measured dependence of the first component upon the P defect concentration, and the calculated positron lifetimes in Si are presented. (GE)

1606 (KHFTI-73-10, pp 65-68) ATOMIC CAPTURE OF NEGATIVE MESONS BY HYDROGENOUS COMPOUNDS. Gol'danskii, V. I. (Inst. of Chemical Physics, Moscow); Kholodov, N. I.; Dzhuraev, A. A.; Evseev, V. S.; Obukhov, Yu. V.; Roganov, V. S.; Frontas'eva, M. V. 1973. (In Russian).

The relative probability for the capture of negative mesons by hydrogen-containing and hydrocarbon groups and aromatic rings in compounds with ion bonds and in alkyl chlorides and iodides and halobenzenes. (tr-auth)

1607 (KHFTI-73-10, pp 90-92) SPIN-EXCHANGE INTERACTIONS OF MUONIUM IN PARAMAGNETIC ION SOLUTIONS. Minaichev, E. V.; Myasishcheva, G. G.; Obukhov, Yu. V.; Roganov, V. S.; Savel'ev, G. I.; Firsov, V. G. 1973. (In Russian).

The dependence of the depolarization rate of μ^+ mesons in aqueous solutions with different concentrations of salts with paramagnetic ions $Cu(NO_3)_2$, $MnCl_2$, $MnSO_4$, and $Mn(NO_3)_2$ was studied. The use of different Mn^{2+} salts was to verify the effect of anions on the spin-exchange interactions of muons (μ^+e^-), formed during the slowing down of the μ^+ mesons in the medium. (INIS)

1608 MUON DECAY IN ORBIT. Haenggi, P.; Viollier, R. D.; Raff, U.; Alder, K. (Basel Univ. (Switzerland)). Phys. Lett., B; 51: No. 2, 119-122(22 Jul 1974).

The decay spectrum of a muon bound in the $1s_{\frac{1}{2}}$ state of an atom is calculated using V-A theory. Accurate muon and electron wave functions including finite nuclear size effects and vacuum polarization are used for the evaluation of the electron emission spectra of various elements. The formalism to perform the angular integration of the matrix elements is developed for the V-A weak interaction. (auth)

1609 SIMPLE RELATION AMONG THE ENERGY LEVEL WIDTHS OF PIONIC ATOMS AND IMAGINARY PART OF π-d SCATTERING LENGTH. Cheon, I. T. (Univ., Liege). Lett. Nuovo Cim.; 11: No. 1, 1-4(7 Sep 1974).

A simple relation among the line widths of pionic atoms is derived on the basis of the nucleon pair model. The imaginary part of the π-d scattering length is predicted to be 0.024 fm. (LBS)

1610 CAPTURE OF NEGATIVE MUONS IN ATOMS. Haff, P.K.; Vogel, P.; Winther, A. (California Institute of Technology, Pasadena, California 91109). Phys. Rev. A 10: No. 4, 1430-1432 (Oct 1974).

The frictional force derived from the stopping power of an electron gas is used in the classical equation of motion for the negative muons. We calculate the energy spectrum of the captured muons and the angular momentum distribution of muons at the energy of the electronic K orbit. The resulting P(l) distribution closely resembles the statistical 2l + 1 distribution. (auth)

1611 SEARCH FOR ORTHOPOSITRONIUM DECAY INTO FOUR PHOTONS AS A TEST OF CHARGE-CONJUGATION INVARIANCE. Marko, K.; Rich, A. (Physics Department, University of Michigan, Ann Arbor, Michigan 48104). Phys. Rev. Lett. 33: No. 16, 980-983 (14 Oct 1974).

We report the preliminary results of an experiment designed to search for the C-non-conserving decay of ground-state orthopositronium (1^3S_1) into four photons. In terms of the branching ratio $F_T^{4\gamma} = R_T^{4\gamma}(^3S_1 \to 4\gamma)/R_{3\gamma}(^3S_1 \to 3\gamma)$, where $R_T^{4\gamma}(^3S_1 \to 4\gamma)$ is the C-non-conserving four-photon decay rate and $R_{3\gamma}(^3S_1 \to 3\gamma)$ is the C-conserving three-photon decay rate of free orthopositronium in our sample, we find $F_T^{4\gamma} < 8 \times 10^{-6}$ (68% confidence). (auth)

1612 MUONIUM FORMATION IN NOBLE GASES AND NOBLE-GAS MIXTURES. Stambaugh, R.D.; Casperson, D.E.; Crane, T.W.; Hughes, V.W.; Kaspar, H.F.; Souder, P. (Gibbs Laboratory, Physics Department, Yale University, New Haven, Connecticut 06520); Thompson, P.A.; Orth, H.; zu Putlitz, G.; Denison, A.B. Phys. Rev. Lett. 33: No. 10, 568-571 (2 Sept 1974).

In an experiment at the Clinton P. Anderson Meson Physics Facility, no muonium formation was found in pure He or Ne, and abundant formation in Ar and Xe. A small Xe admixture (0.1%) in He and Ne resulted in abundant muonium formation, due to the process in which Xe serves as an electron donor to a low-energy positive muon. These results are qualitatively consistent with our knowledge of relevant atomic collision cross sections. (auth)

1613 BEHAVIOR OF POSITIVE MUONS IN LIQUID HELIUM. Crane, T.W.; Casperson, D.E.; Chang, H.; Hughes, V.W.; Kaspar, H.F.; Lovett, B.; Schiz, A.; Souder, P.; Stambaugh, R.D.; zu Putlitz, G. (Gibbs Laboratory, Physics Department, Yale University, New Haven, Connecticut 06520); Kane, J.R. Phys. Rev. Lett. 33: No. 10, 572-574 (2 Sept 1974).

Searches were made with positive muons stopped in liquid helium for free-muon precession, for muonium precession, and for depolarization of the muon spin. The muons behaved as free muons both above and below the λ point. There was no muonium formation (<2%) and no depolarization of the muon spin (depolarization time >20 μsec). (auth)

1614 TWO-MUONIC ATOMS. Fricke, B. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)); Desclaux, J. P. (Institut Max von Laue - Paul Langevin, 38 - Grenoble (France)). Phys. Lett., B; 51: No. 4, 317-319(19 Aug 1974).

X-ray transition energies for two-muonic atoms are calculated. The basis is relativistic self-consistent-field calculations including the corrections normally known in muonic atoms plus the vacuum polarization, magnetic interaction and retardation in the $\mu-\mu$ interaction, the specific mass correction and the configuration interaction. (auth)

1615 THE TEMPERATURE DEPENDENCE OF THE HEIGHT OF ANGULAR CORRELATION ANNIHILATION SPECTRUM. Vlachynsky, J.; Cizek, A. (Ceskoslovenska Akademie Ved, Brno. Ustav Fyzikalni Metalurgie). Phys. Lett., A; 49: No. 1, 43-44 (12 Aug 1974).

Annihilation of positrons seems to be a promising method of the study of lattice defects. Unfortunately, the results of some authors have shown that this technique is not useful for all metals. Seeger (1973) explained this fact by the nonexistence of positron trapping by defects. Nevertheless, his theoretical criteria do not account well for all negative results. In this letter it is shown that the height of angular correlation spectrum may not change, even though the positrons are trapped by the defects. (auth)

Collision Phenomena

1616 (AD-776055) THEORETICAL FOUNDATION FOR A GENERAL QUANTAL MOLECULAR REACTION RATE CODE. Volume II. Outline of Close Coupling Formalism in the Separated Atom Approximation. Final Report, 22 May-9 December 1973. Smith, K. (Quantum Systems, Inc., Albuquerque, N. Mex. (USA)). Feb 1974. Contract F29601-72-C-0116. 69p. (AFWL-TR-73-235-VOL-2). NTIS $3.75.

The close coupling formalism for collisions of diatomic molecules with atoms and other diatomic molecules is outlined within the framework of the separated atom approximation. The electronic states of the molecules are approximated by products of atomic wave functions and the interaction potentials are taken to be linear superpositions of long range atom-atom potentials. The suggested algorithms permit the calculations of cross sections involving simultaneous changes in electronic, vibrational, and rotational states of the target molecule. (auth)

1617 (AD-778024) ELECTRON IMPACT CROSS SECTIONS AND RATES FOR ONE- AND TWO-ELECTRON ALUMINUM IONS. Oran, E.; Davis, J. (Naval Research Lab., Washington, D. C. (USA)). Apr 1974. 17p. (NRL-MR-2694). NTIS $3.00.

A semi-classical impact parameter method was used to calculate the gaunt factors, cross sections, and rates for electron impact excitations between selected states of the hydrogen- and helium-like ions of aluminum. These results are compared to the "universal" values suggested by Allen. For the resonance

transitions, agreement with Allen's values becomes worse as the charge on the target increases. Agreement is good for the nonresonant transitions. (auth)

1618 (AD-778961) BOLTZMANN COLLISION OPERATOR WITH INVERSE-POWER INTERMOLECULAR POTENTIALS. Pao, Y. P. (New York Univ., N. Y. (USA)). Jan 1974. 70p. (MF-74; AFOSR-TR-74-0739). NTIS $6.50.

The linearized collision operator in the Boltzmann equation with repulsive intermolecular potentials $V(R) = A(R^{-\alpha})$ is studied. It is shown that for $\alpha > 2$ the collision operator has a purely discrete spectrum and its eigenfunctions are infinitely differentiable (L^2)-functions which are complete in (L^2). The proof relies on the formalism of pseudo-differential operators. The special case of $\alpha = 4$, the Maxwell's molecules, and the general case of inverse-power potentials with $\alpha > 2$ are considered. (auth)

1619 (AD-779684) FORMATION OF N_2^+(B doublet Σ^+(U)) AND N_2(C triplet Π(U)) IN COLLISIONS OF H^+ AND H WITH N_2. Birely, J. H. (Aerospace Corp., El Segundo, Calif. (USA)). 25 Apr 1974. Contract F04701-73-C-0074. 39p. (SAMSO-TR-74-109). NTIS $3.25.

The 200 to 500-NM radiation excited by collisions of beams of 1 to 25-keV H^+, D^+, H, and D with N_2 was studied under thin target conditions with a viewing geometry chosen to minimize polarization effects. Excitation and ionization are discussed. Cross sections are calculated. Experimental and data reduction aspects are considered. (auth)

1620 (ANL-8096, pp 59-64) MOLECULAR-BEAM STUDIES. Wexler, S.; Parks, E. K.; Young, C. E.; Cohen, R. B.; Pobo, L. G. Apr 1974.

In Chemistry Division annual report, July 1972-June 1973.

The following subjects are treated: associative, reaction, and electron-transfer ionization in collisions of uranium atoms with O_2 molecules; chemi-ionization reactions of accelerated metal atoms (Ba) and of accelerated carbon atoms with O_2 molecules; and collision-induced ion-pair formation of TlF and Tl_2F_2. Yields, angular distributions, and cross sections are given. (6 figures) (RWR)

1621 (ANL-8096, pp 131-142) THEORETICAL CHEMISTRY. Apr 1974.

In Chemistry Division annual report, July 1972-June 1973.

The first part of this section is devoted to scattering theory and dynamics. To resolve some experimental discrepancies and extend the evaluation of van der Waals (VDW) forces to larger systems, the VDW interaction of ArH was evaluated by the multiconfiguration-self-consistent-field technique. An extensive study of the nonreactive part of the Li-H_2 potential energy surface (PES) was nearly completed; these results permitted a realistic study of the PES sensitivity of the inelastic scattering of Li from H_2. Reactive and dissociative scattering in collisions of rare gases with thallium halides were also addressed. Work was also performed in the following areas: Studies of atmospheric diatomic and triatomic species; structure of spectra of diatomic molecules; assignment and prediction of infrared, ultraviolet, and visible absorption (and emission) spectra; calculation of electronic and vibrational transition moments of diatomic and polyatomic molecules; the evaluation of van der Waals forces; potential energy surfaces and dynamics; relativistic calculation of atomic properties; calculation of atomic and molecular polarizabilities; application of computer graphics to the display of molecular processes; development of theoretical techniques and computing systems; and foundational problems in physics. (15 figures, 4 tables) (RWR)

1622 ELECTRON BREMSSTRAHLUNG FROM NEUTRAL ATOMS. Tseng, H. K.; Pratt, R. H. (Univ. of Pittsburgh). Phys. Rev. Lett.; 33: No. 9, 516-518(26 Aug 1974).

The complete energy spectrum for electron bremsstrahlung was obtained, by using a numerical calculation in partial waves with numerical potentials corresponding to neutral atoms. Sample spectra are presented for electrons of kinetic energy 50 keV incident on Au and Al. The connections between elastic electron scattering and the low frequency region of the bremsstrahlung spectrum and between photoeffect and the high frequency region of the bremsstrahlung spectrum are demonstrated. (auth)

1623 SCATTERING OF ALKALI HALIDES BY ELECTRONS. III. KI. Slater, R. C.; Fickes, M. G.; Becker, W. G.; Stern, R. C. (Columbia Univ., New York). J. Chem. Phys.; 61: No. 6, 2290-2293(15 Sep 1974).

Scattering of KI by 0.81 to 5.7 eV electrons was observed using the molecular beam recoil technique. Center of mass cross section models are adjusted to fit the apparatus space scattering pattern. Absolute total cross sections agree at high energies with the first Born approximation and are a factor of 4 smaller at the lowest energy. At low energies the momentum transfer cross sections are an order of magnitude below theory. The measured cross sections are nominally identical to those measured in CsCl. (auth)

1624 PARALLEL INTERPRETATIONS FOR LEVEL MATCHING ENHANCEMENTS IN INNER-SHELL VACANCY PRODUCTION IN ION-ATOM COLLISIONS. McGuire, J. H. (Kansas State Univ., Manhattan (USA). Dept. of Physics). Phys. Lett., A; 48: No. 5, 387-388(15 Jul 1974).

In the last few years there has been considerable interest in observations of X-ray production cross sections in ion-atom collisions which are relatively large whenever the energy level of the electron removed matches an energy level in the other participating atomic system. Often these X-ray production cross sections, corresponding to inner-shell vacancies, exceed cross sections predicted by direct Coulomb ionization. From the point of view of a theorist, it is difficult to envision practical calculations which are sufficiently detailed to completely describe such a complex ion-atom collision. However, the general features of these observations can be qualitatively (and in some cases quantitatively) explained in terms of the molecular orbital model, where vacancies are produced by level crossing-electron promotion occurring when the two atoms come together to form a molecule temporarily. This is a way of rearranging electrons. Another simple way to rearrange electrons is via direct charge exchange. In this note, it is demonstrated that the features of the observed X-ray enhancements can be qualitatively explained in terms of direct charge exchange. (NL)

1625 RADIATIVE RECOMBINATION OF ELECTRONS WITH HYDROGEN ATOMS. Callaway, J. (Louisiana State Univ., Baton Rouge (USA). Dept. of Physics and Astronomy). Phys. Lett., A; 48: No. 5, 359-360(15 Jul 1974).

The rate coefficient for the reaction $H + e \rightarrow H^- + \hbar\omega$ is computed by detailed balance using the known cross section for the inverse reaction for electron temperatures in the range $0°K \rightarrow 10000°K$. (auth)

1626 OSCILLATIONS IN THE CROSS SECTIONS FOR ELECTRONIC EXCITATION IN HEAVY PARTICLE COLLISIONS. Andresen, P.; Dueren, R. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen (F. R. Germany)). Chem. Phys. Lett.; 27: No. 1, 114-117(1 Jul 1974).

The electronic excitation in atom-atom collisions is treated by describing the heavy-particle motion in the Born approximation. To deal with the electronic wavefunction it will be in many cases a reasonable first approximation to assume a one-electron model for one atom and keep the other atom in the initial state. In this model the scattering amplitude is shown to depend only on the interaction of this one electron with the target and the form factor of the respective states. Calculations for this one-electron model are presented, and they show an oscillatory behavior in the integral cross section. These oscillations are due to the electron-target interaction. The results are in good agreement with experimental data. (auth)

1627 R-MATRIX THEORY OF REACTIVE ATOM-DIATOM COLLISIONS. Der, R.; Gebhardt, O.; Haberlandt, R. (Zentralinstitut fuer Isotopen- und Strahlenforschung, 705 Leipzig, GDR). Chem. Phys. Lett.; 27: No. 1, 107-110(1 Jul 1974).

For chemical reactions, R-matrix theory is demonstrated to be well suited both as a computational tool and for investigations of the reaction mechanism. Transition probabilities are calculated for three different potential surfaces, and the results, discussed in terms of resonance states. (auth)

1628 MEASUREMENTS OF THE ELECTRONIC EXCITATION IN ATOMIC COLLISIONS OF POTASSIUM WITH THE RARE GASES. Dueren, R.; Kick, M.; Pauly, H. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen (F. R. Germany)). Chem. Phys. Lett.; 27: No. 1, 118-122(1 Jul 1974).

Excitation cross sections for the potassium $4^2P_{\frac{1}{2}}$ and $4^2P_{\frac{3}{2}}$ states produced in collisions with rare gases are reported. They have been measured by the light yield as a function of the energy from 100 to 2500 eV. In addition to this, a spectral analysis from 3300 to 8600 Å of the light is given for some energies. This spectral analysis gives experimental evidence that the excited and ionized states of both potassium and the rare gases are involved in the collision process. (auth)

1629 PHOTOIONIZATION CROSS SECTION OF URANIUM IN THE SOFT X-RAY REGION. Cukier, M.; Dhez, P.; Wuilleumier, F.; Jaegle, P. (Paris-6 Univ., 75 (France). Lab. de Chimie Physique). Phys. Lett., A; 48: No. 4, 307-308(1 Jul 1974).

The photoionization cross section of uranium was determined experimentally in the soft X-ray region (130 eV-450 eV) by direct photoabsorption measurements using the synchrotron radiation emitted by the LURE-ACO storage ring. (auth)

1630 A LOW ENERGY ICR STUDY OF THE SYMMETRIC CHARGE TRANSFER REACTION $^3He^+ + {}^4He \rightarrow {}^4He^+ + {}^3He$. Smith, R. D.; Futrell, J. H. (Utah Univ., Salt Lake City (USA). Dept. of Chemistry). Chem. Phys. Lett.; 27: No. 4, 493-495(15 Aug 1974).

The kinetic energy dependence of the charge transfer reactions $^3He^+ + {}^4He \rightleftharpoons {}^3He + {}^4He^+$ was investigated using a modified ion cyclotron double resonance technique. The rate constant increases monotonically from $(5.0 \pm 0.5) \times 10^{-10}$ cm^3 molecule^{-1} sec^{-1} at 0.1 eV to 55×10^{-10} cm^3 molecule^{-1} sec^{-1} at a relative kinetic energy of 25 eV. The results compare favorably with theoretical predictions for symmetric resonance charge transfer. (auth)

1631 COHERENCE IN He I AND II EXCITED STATES PRODUCED BY AN ASYMMETRIC COLLISION. Church, D.A.; Kolbe, W.; Michel, M.C.; Hadeishi, T. (Lawrence Berkeley Laboratory, Berkeley, California 94720). Phys. Rev. Lett. 33: No. 10, 565-568 (2 Sept 1974).

In an external magnetic field, quantum beats at the Larmor frequency ω are observed in circularly polarized light as a result of coherent orientation of fast He I and II states by a thin foil with exit-surface normal not coincident with the beam direction. Effects resulting from variation of detection geometry, quantum state, incident ion energy, foil tilt angle, and foil material are discussed. An interpretation in terms of an impulsive asymmetric electric interaction is considered. (auth)

1632 SIMPLIFIED VARIATIONAL METHOD FOR P-WAVE ELECTRON-HYDROGEN SCATTERING. Ajmera, M.P.; Chung, K.T. (Department of Physics, North Carolina State University, Raleigh, North Carolina 27607). Phys. Rev. A 10: No. 4, 1013-1018 (Oct 1974).

The simplified Kohn-Feshbach variational method is used to study the phase shifts for the P-wave electron-hydrogen system. Unlike earlier calculations where the curve fitting is used to calculate the width and the shift for a resonance state, we obtained these quantities by direct integration. This permits us to study the variation of Γ (E) and Δ (E) in the resonance region and a well-defined resonance energy position can be found. In the elastic region we obtained two resonances each for triplet and singlet states. These resonance positions compare favorably with previous accurate calculations. (auth)

1633 GENERALIZED OSCILLATOR STRENGTHS FOR THE $(1s^22s^2)^1S \rightarrow (1s^22s2p)^1P$ TRANSITION IN SOME Be-LIKE IONS. Banyard, K.E.; Taylor, G.K. (Department of Physics, University of Leicester, Leicester, England). Phys. Rev. A 10: No. 4, 1019-1027 (Oct 1974).

Generalized oscillator strengths f(K) have been calculated for the $(1s^22s^2)^1S \rightarrow (1s^22s2p)^1P$ transition of the Be-like ions when Z = 4-8. A "length" formula and two versions of a "velocity" formula for f(K) were used in each instance. For each ion, K- and L-intrashell pair correlation functions were included in the description of the ground-state wave function, and the K-shell pair function was also introduced into the excited state. The pair functions were determined after the general manner proposed by Sinanoğlu. For K = 0, f(K) is equivalent to the optical oscillator strength and our results can therefore be compared with several other theoretical values and with experiment. The excellent agreement of our f(0) values when compared with experiment, coupled with the high degree of consistency amongst the f(K) values when evaluated, in turn, from the three formulations mentioned above, suggests that our correlated results should possess considerable reliability, particularly at the lower end of the Z range. The sensitivity of the f(K) values to the presence of electron correlation effects has been examined by repeating the calculations using Hartree-Fock descriptions for both the ground and excited states. Comparison between our correlated and noncorrelated results revealed that the presence of the pair functions was indispensable in order to achieve agreement between f(K) values derived from the "length" and "velocity" formulations. For Be, the f(K) values were used to obtain total inelastic scattering cross sections, within the first Born approximation, for both proton and electron impact. Although our allowance for electron correlation produced significant changes in the "length"-based cross sections, "velocity" values proved to be considerably less sensitive over a large energy range for both types of projectile. (auth)

1634 X RAYS FROM ATOMIC SYSTEMS OF COMBINED Z $\simeq$ 130. Jundt, F.C.; Kubo, H.; Gove, H.E. (Nuclear Structure Research Laboratory, University of Rochester, Rochester, New York 14627). Phys. Rev. A 10: No. 4, 1053-1064 (Oct 1974).

The x-ray spectrum in the region from about 2 to 42 keV has been measured for 25-MeV iodine ions incident on thick and thin gold targets, 37.8-MeV gold ions incident on thick tin targets, and 23.9-MeV gold ions incident on thick gold targets. The spectra were obtained for several values of aluminum absorbers inserted between the target and detector. The broad band of x-ray emission lying in energy between about 6.5 and 9.5 keV observed by Mokler et al. is confirmed as is their suggestion that it arises from M x rays from the quasiatom system of Z $\simeq$ 130. A search for L x rays from these systems was inconclusive. (auth)

1635 Z DEPENDENCE OF Kα X-RAY SATELLITE STRUCTURE IN HEAVY-ION-ATOM COLLISIONS. Watson, R.L.; Jenson, F.E.; Chiao, T. (Department of Chemistry and Cyclotron Institute, Texas A & M University, College Station, Texas 77843). Phys. Rev. A 10: No. 4, 1230-1244 (Oct 1974).

The spectra of Kα x rays emitted as a result of heavy-ion-atom collisions have been measured with a Bragg spectrometer using a variety of equal velocity (1.7 MeV/amu) heavy ions ranging from $_1$H to $_{18}$Ar incident on solid targets containing atoms of $_{13}$Al, $_{17}$Cl, and $_{19}$K. In the cases of Cl and K, the measured K$\alpha_{1,2}$-Kα satellite energy differences for one through seven L-shell vacancies were found to be systematically larger than those calculated using the Herman-Skillman Hartree-Fock-Slater program. Values of the binomial probability parameter obtained by fitting the relative satellite intensities with binomial distributions have been compared to theoretical values calculated using an impact-parameter formulation of the binary-encounter approximation. In the Al spectra obtained with S and Ar ions, the K$\alpha_{1,2}$ peak is observed to have an intensity six to seven times larger than is expected on the basis of a binomial fit to the satellite peaks. (auth)

1636 MEASUREMENT OF ELASTIC-SCATTERING RELATIVE DIFFERENTIAL CROSS SECTIONS FOR ELECTRON-HELIUM COLLISIONS AT LOW ENERGIES AND SMALL ANGLES. Arnow, M.M. (Department of Physics, The University of Cincinnati, Cincinnati, Ohio 45221). Phys. Rev. A 10: No. 4, 1223-1229 (Oct 1974).

The experiment presented measures the relative differential cross sections in helium for the energies between 1.0 and 10.0 eV and at the angles 10°, 15°, 20°, 25°, and 30°. The results are compared to the experiments of others and are also compared to the present theories. Since experiments do not overlap very well in this region, conclusions are difficult to draw. It is easier, however, to make comparisons to the theoretical predictions. It is shown that the results of this experiment do not agree well with the theoretical predictions. (auth)

1637 AUGER DECAY OF NEON FOLLOWING ENERGETIC ION BOMBARDMENT. Matthews, D.L.; Johnson, B.M.; Mackey, J.J.; Smith, L.E.; Hodge, W.; Moore, C.F. (Center for Nuclear Studies, The University of Texas at Austin, Austin, Texas 78712). Phys. Rev. A 10: No. 4, 1177-1187 (Oct 1974).

A high-resolution double-focusing electrostatic electron analyzer has been used to resolve Ne Auger electrons produced by 0.15-6.0-MeV H^+, 1.0-MeV He^+, and 33-MeV O^{5+} bombardment. Individual K-Auger satellite lines stemming from the decay of multiply ionized neon have been observed. The energies, relative intensities, and production probabilities of these satellite lines were measured as a function of the projectile Z and as a function of proton bombarding energy. Tentative identifications for all observed lines were made by comparison with calculated Auger satellite transition energies. The reliability of the Hartree-Fock calculations used was demonstrated by comparison with e^- + Ne data and by comparing calculated x-ray transition energies for multiply ionized neon to recent measurements of O + Ne x-ray lines. A rough estimate of the probability of single- and double-2s orbital vacancy production as a function of L-shell defect was obtained. With proton bombardment, the satellite-production probability Q_s was observed to decrease smoothly with increasing proton energy. The observation that Q_s for 6-MeV proton bombardment was approximately equal to that obtained with equal-velocity electrons is believed to imply that electron shakeoff is the dominant L-shell ionization mechanism for high-energy proton bombardment. (auth)

1638 EXCITATION CROSS SECTIONS OF $e^- + He \rightarrow e^- + He(3\,^1P, 4\,^1P)$ AND THE POLARIZATION OF THE 5016-Å HELIUM LINE RESULTING FROM e^--He SCATTERING IN GLAUBER THEORY. Chan, F.T.; Chen, S.T. (Physics Department, University of Arkansas, Fayetteville, Arkansas 72701). Phys. Rev. A 10: No. 4, 1151-1156 (Oct 1974).

The recently derived generating function $I_p(\lambda_1, \lambda_2; q)$ in the Glauber amplitude for 2 ^1P excitation of He by electron impact is used to evaluate the cross sections for the 3 ^1P and 4 ^1P excitations of He by electron impact with incident energies from 50 to 1000 eV. Comparison is made with the Bethe approximation, the Born approximation, and the classical theory of Gryzinski. The theoretical results for the total excitation cross sections are in reasonable agreement with the experimental data. The positions of the peak values for the total cross section for both cases are found to be around 100 eV, which are consistent with the existing experimental findings. The n^{-3} rule is also briefly discussed. The polarization fraction of the 5016-Å helium line emitted in e^- + He collisions is also calculated in the Glauber approximation. The theoretical results for the polarization fraction are in reasonable agreement with the existing experimental data in the energy range $50 < E_a < 1000$ eV. (auth)

1639 PROTON IONIZATION OF THE L SUBSHELLS OF Pr, Eu, Gd, AND Dy: 0.3 TO 2.0 MeV. Abrath, F.; Gray, T.J. (Department of Physics, North Texas State University, Denton, Texas 76203). Phys. Rev. A 10: No. 4, 1157-1161 (Oct 1974).

Total L–shell ionization cross sections were measured for Pr, Eu, Gd, and Dy over the energy range 0.3 to 2.0 MeV and compared to the nonrelativistic plane–wave Born approximation (PWBA), the constrained binary–encounter approximation (CBEA), and the binary–encounter approximation. Both the PWBA and CBEA predicted the measured values. Also the $L\alpha_{1,2}/Li$, $L\alpha_{1,2}/L\gamma_1$, $L\alpha_{1,2}/L\gamma_{2,3}$, and $L\gamma_1/L\gamma_{2,3}$ ratios were measured and compared with PWBA and CBEA. The results showed that the CBEA and PWBA accurately predicted the L_{II}– and L_{III}–subshell ionization cross sections, while only the PWBA accurately predicted the L_I–subshell ionization cross section. (auth)

1640 PRODUCTION OF LYMAN-α RADIATION IN COLLISIONS OF PROTONS AND HYDROGEN ATOMS. Kondow, T.; Girnius, R.J.; Chong, Y.P.; Fite, W.L. (Department of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). Phys. Rev. A 10: No. 4, 1167-1176 (Oct 1974).

The cross sections for Lyman–α production by the processes H^+ (or D^+) + H(1S) → H^+ (or D^+) + H(2P) (direct excitation) and H^+ (or D^+) + H(1S) → H(2P) [or D(2P)] + H^+ (charge transfer) have been measured over the energy range 0.75–29 keV using a modulated cross–beam technique with liquid–helium cryopumping. Signals from the direct excitation and the charge transfer were separated by a Doppler–shift technique. The absolute cross sections were assigned by comparison with excitation of Lyman–α on electron impact. For direct excitation, general agreement in shape with the data of Stebbings et al. and of Morgan, Geddes, and Gilbody was found except for structure at 1.3 keV. The pseudostate calculations of Cheshire, Gallaher, and Taylor predicted the present experimental points well. For charge transfer, our results agree with those of Morgan, Geddes, and Gilbody at energies higher than 11 keV and have similarity in shape to the work of Stebbings et al. A peak appeared in our cross–section curve at the energies around 1.7 keV. Acceptable agreement with the pseudostate calculations was found up to the maximum energy except for the appearance of the peak at 1.7 keV. (auth)

1641 K–SHELL IONIZATION CROSS SECTIONS FOR ELEMENTS Se TO Pd: 0.4–2.0 MeV. Criswell, T.L.; Gray, T.J. (Department of Physics, North Texas State University, Denton, Texas 76201). Phys. Rev. A 10: No. 4, 1145-1150 (Oct 1974).

K–shell ionization cross sections for protons over the energy range of 0.4–2.0 MeV have been measured on thin targets of the elements Se, Br, Rb, Sr, Y, Mo, and Pd. Total x–ray and ionization cross sections for the K–shell are reported. The experimental values of the ionization cross sections are compared to the nonrelativistic plane–wave Born approximation, the binary–encounter approximation, the constrained binary–encounter approximation, and the plane–wave Born approximation with corrections for Coulomb–deflection and binding–energy effects. (auth)

1642 ELECTRON EXCITATION OF THE LITHIUM 6708–A RESONANCE LINE. Leep, D.; Gallagher, A. (Joint Institute for Laboratory Astrophysics, University of Colorado and National Bureau of Standards, Boulder, Colorado 80302). Phys. Rev. A 10: No. 4, 1082-1090 (Oct 1974).

We have measured the relative optical excitation function and the polarization of the 6708–Å line, using crossed beams of electrons and lithium–6, for electron energies from threshold to 1400 eV. The electron energy resolution was ~ 0.25 eV, and the lithium–beam optical depth was small and varied. We have normalized our excitation function to Born theory at 1404 eV, where the energy dependence has converged to the theoretical behavior. Between 2 and 6 eV, the measured cross section is (10–45) % smaller than the results of the most recent close–coupling calculations, but the measured polarization P agrees with these theories within 20% of P. The thoretical polarization at threshold is not observed with our energy resolution. (auth)

1643 NEON Kα, Kβ SATELLITE STRUCTURE INDUCED BY 80–MeV ARGON–ION IMPACT. Mowat, J.R.; Laubert, R.; Sellin, I.A. (Department of Physics and Astronomy, The University of Tennessee, Knoxville, Tennessee 37916 and Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830); Kauffman, R.L.; Brown, M.D.; Macdonald, J.R.; Richard, P. Phys. Rev. A 10: No. 4, 1446-1449 (Oct 1974).

High–resolution (full width at half–maximum ~ 3 eV) neon K x–ray spectra obtained from 80–MeV argon–ion bombardment are presented for two narrow ranges of the projectile charge state (q = ~6, ~14). Production of the various satellite lines is found to depend on the projectile charge state. When the projectile is Ar^{14+}, the target is at least 6 times ionized, and a significant fraction (> 20%) of the observed radiation comes from hydrogenlike and heliumlike ions. We comment on the reliability of vacancy–production cross sections deduced from measured x–ray intensities. (auth)

1644 OBSERVATION OF UPPER–STATE ($00^0 1$) EFFECTS IN THE DETECTION OF MOMENTUM TRANSFER IN ROTATIONALLY INELASTIC COLLISIONS OF CO_2 WITH HYDROGEN. Meyer, T.W.; Bischel, W.K. (University of California, Department of Applied Science, Davis–Livermore, California 94550); Rhodes, C.K. Phys. Rev. A 10: No. 4, 1433-1434 (Oct 1974).

We have detected previously unobserved momentum–transfer distributions generated by rotationally inelastic molecular collisions of CO_2 and H_2 involving only the $00^0 1$ state. (auth)

1645 CALCULATED ELECTRON EXCITATION CROSS SECTIONS FOR THE ALKALIS. Greene, T. J.; Williamson, W. Jr. (Univ. of Toledo). At. Data Nucl. Data Tables; 14: No. 2, 161-175(Aug 1974).

Electron excitation cross sections for lithium, sodium, potassium, rubidium, and cesium were calculated by means of the Born, Bethe, and Ochkur approximations. Herman–Skillman Hartree–Fock–Slater wave functions are used to describe the bound electrons. (5 tables) (auth)

1646 CHARACTERIZATION OF CHARGE STATES OF ENERGETIC IONS IN SOLIDS FROM ASSOCIATED K X–RAY PRODUCTION. Datz, S.; Appleton, B.R. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830); Mowat, J.R.; Laubert, R.; Peterson, R.S.; Thoe, R.S.; Sellin, I.A. Phys. Rev. Lett. 33: No. 13, 733-736 (23 Sept 1974).

The strong projectile–charge–state dependence of K x–ray production in gases establishes a charge–state scale for ions penetrating solids. Si K x–ray cross sections in gaseous SiH_4 were compared to those in solid Si for 40–MeV O (6+ to 8+) and 86–MeV Ar (6+ to 16+) projectiles. For Ar an effective charge of 11 ± 1 is found compared to an emergent charge of 14.8 ± 0.5. The result is discussed in terms of alternate models for steady–state excitation in solids. (auth)

1647 NEW TECHNIQUE FOR THE MEASUREMENT OF LIFETIMES OF HEAVY–ION INNER–SHELL VACANCIES. Betz, H.; Bell, F.; Panke, H.; Kalkoffen, G.; Welz, M.; Evers, D. (Sektion Physik, Universität München, 8046 Garching, Germany). Phys. Rev. Lett. 33: No. 14, 807-810 (30 Sept 1974).

We report a new technique for the measurement of short lifetimes (10^{-14} sec) of inner–shell vacancies in heavy–ion projectiles moving through thin, solid targets. The technique is applicable whenever the yield of projectile x rays does not increase in proportion to target thickness. Lifetime values of 1.5×10^{-14} and 3.3×10^{-14} sec have been found for Kα and Kβ transitions, respectively, in highly stripped sulfur ions. (auth)

1648 PENNING–TRAP TECHNIQUE FOR STUDYING ELECTRON–ATOM COLLISIONS AT LOW ENERGY. McGuire, M.D.; Fortson, E.N. (Department of Physics, University of Washington, Seattle, Washington 98195). Phys. Rev. Lett. 33: No. 13, 737-739 (23 Sept 1974).

In a new technique for studying electron collisions, the electrons are confined by electromagnetic fields and exposed to a known low density of atoms or molecules. Collision rates are measured by electron diffusion in the trap. The use of spin–oriented atoms allows triplet and singlet contributions to be separated. Results of such studies are reported for room–temperature collisions of electrons with potassium atoms and with nitrogen molecules. (auth)

1649 INTRODUCTION TO THE SYMPOSIUM ON THE JESSE EFFECT AND RELATED PHENOMENA. Inokuti, M. (Argonne National Lab., IL). Radiat. Res.; 59: No. 2, 343-349(Aug 1974).

Nearly a quarter of a century ago Jesse discovered that a minute amount of contaminants greatly enhances the total ionization of helium gas by alpha particles. The discovery has stimulated many workers to study the role of metastable and other excited species in gaseous mixtures, a subject that now has numerous ramifications and applications. The present symposium was conceived for reviewing the current understanding of the Jesse effect and its microscopic mechanisms, which include collisions and quenching of excited atoms, Penning ionization, properties of diatomic rare-gas molecules, photoionization, and transport of resonance radiations. Related macroscopic phenomena concern gaseous discharges and vuv lasers. (auth)

1650 CLOSE COLLISIONS OF SWIFT POSITRONS AND ELECTRONS WITH STRING ATOMS. Vorobiev, A. A.; Kudrin, V. V.; Vorobiev, S. A. (Tomskij Politekhnicheskij Inst. (USSR)). Phys. Lett., A; 49: No. 1, 49-50(12 Aug 1974).

A computer simulation of the scattering of 20 MeV positrons and electrons in ⟨100⟩ MgO single crystal was performed. The flux distributions of the incident particles near by the atomic string were calculated in their development with penetration depth. (auth)

1651 THE MECHANISMS OF COLLISION-INDUCED DISSOCIATION. Anderson, S. J.; Swan, J. B. (Western Australia Univ., Nedlands. Dept. of Physics). Phys. Lett., A; 48: No. 6, 435-436(29 Jul 1974).

The energy distributions of H_2^+ and D_2^+ fragments from collision-induced dissociation of 0.2–2.6 keV H_2^+ and D_2^+ ions reveal that dissociation occurs via polarization-induced vibrational-rotational excitation and rotational predissociation, in addition to the well-known electronic excitation. (auth)

1652 COMMENT ON THE HIGH-FREQUENCY LIMIT OF THE BREMSSTRAHLUNG CROSS SECTION. Haug, E. (Tuebingen Univ. (F. R. Germany)). Phys. Lett., A; 49: No. 1, 68 (12 Aug 1974).

Referring to recent papers the validity of the bremsstrahlung cross section at the high-frequency limit, as obtained by use of the Sommerfeld-Maue wave function, is discussed. (auth)

Atomic Theory

Refer also to abstract 652.

1653 ADAPTATION OF A GENERAL PROGRAM TO CALCULATE ANGULAR MOMENTUM INTEGRALS IN ATOMIC STRUCTURE: INCLUSION OF THE ONE-ELECTRON PART OF THE HAMILTONIAN. Hibbert, A. (Queen's Univ., Belfast, Northern Ireland (UK). Dept. of Applied Mathematics). Comput. Phys. Commun.; 7: No. 6, 318-326(Jun 1974).

The adaptation allows the matrix elements of the full Hamiltonian to be expressed as weighted sums of radial integrals. The coefficients of these integrals are expressed in terms of fractional parentage coefficients and recoupling coefficients, using the techniques of Racah algebra. (NL)

1654 INTRODUCTION TO QUANTUM OPTICS. Nussenzveig, H. M. Documents on Modern Physics. New York; Gordon and Breach, Science Publishers, Inc. (1973). 256p. $19.95.

The topics covered include classical and quantum coherence functions, coherent states, applications, the laser, semiclassical and quantum theory of the laser, superradiance, photon echoes and self-induced transparency, and recent developments in quantum optics. (JFP)

1655 THEORETICAL STUDY OF THE SPECTRAL LINE WIDTH. Ionescu-Pallas, N. J. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 25: No. 8, 891-895 (1973). (In Rumanian).

A semi-empirical formula for composing spectral widths of various kinds is derived proceeding from known two width formulas and accounting for some symmetry restrictions. (auth)

1656 REMARK ON THE MANY-BODY PROBLEM FOR COMPOSITE PARTICLES. Popovic-Bozic, M. (Inst. of Physics, Belgrade). Fizika (Zagreb); 6: No. 2, 99-111(Jul 1974).

The dependence of symmetry conditions related to the exchange of electron and nuclei between atoms in a Girardeau's theory for many atom problem is studied. Effects of interatomic exchange of electrons are incorporated into the ≫ projected Hamiltonian ≪ so that, when exchanges of electrons between atoms vanish, it tends to the Hamiltonian in which only the permutations of atoms as a whole are incorporated. (auth)

1657 RADIAL FUNCTIONS OF ATOMS WITH THE ELECTRON INTERACTION BEING TAKEN INTO ACCOUNT. Solodukhin, A. M.; Fedorov, F. I. (Belorussian State Univ., Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 4, 45-50 (1974). (In Russian).

The system of equations of a self-consistent Hartree field, determining the function of the first approximation, is used to find analytical radial functions of atoms. In a first approximation of perturbation theory the single-electron equation of the Hartree system is solved for an arbitrary state of an electron in a multielectron atom. An explicit form of functions of 1s and 2s electrons is presented with the effect of the other 1s and 2s electrons being taken into account. (SJR)

1658 QUANTUM PHYSICS OF ATOMS, MOLECULES, SOLIDS, NUCLEI, AND PARTICLES. Eisberg, R.; Resnick, R. New York; John Wiley and Sons, Inc. (1974). 798p. $16.95.

The topics covered include thermal radiation and Planck's postulate, photons–particlelike properties of radiation, De Broglie's postulate – wavelike properties of particles, Bohr model of the atom, the Schroedinger theory of quantum mechanics, solutions of time-dependent Schroedinger equations, one-electron atoms, magnetic dipole moments, spin, and transition rates, multielectron atoms–ground states and x-ray and optical excitations, quantum statistics, molecules, conductors and semiconductors, superconductors and magnetic properties, nuclear models, nuclear decay and nuclear reactions, and elementary particles. (JFP)

1659 TOTAL AND PARTIAL ATOMIC-LEVEL WIDTHS. Keski-Rahkonen, O.; Krause, M. O. (Oak Ridge National Lab., TN). At. Data Nucl. Data Tables; 14: No. 2, 139-146(Aug 1974).

Total and partial atomic-level widths of the K, L, M, and N levels of the elements (covering Z up to 120 for K and L levels) are presented in graphic form. Graphs are based on theoretical predictions; total widths are natural level widths as governed by the rates of the various deexcitation processes for a single hole in that level. The drawings make possible, throughout the periodic table, a quick survey of the magnitude and trends of the total level widths, rates and yields of radiative, Auger, and Coster–Kronig processes, and widths of x-ray, Auger, and Coster–Kronig lines. (auth)

1660 RELATIVISTIC HARTREE–SLATER VALUES FOR K AND L X-RAY EMISSION RATES. Scofield, J. H. (Lawrence Livermore Lab., Livermore, CA). At. Data Nucl. Data Tables; 14: No. 2, 121-137(Aug 1974).

The x-ray emission rates for the filling of K- and L-shell vacancies, calculated with the relativistic Hartree–Slater theory, are given for elements with Z = 5 to 104. Account was taken of the finite extent of nuclear-charge distributions. Presented are ratios of the major K-shell components, the total K- and L-shell radiative decay rates, and the rates of emission of individual x-ray lines. (5 tables) (auth)

1661 X-RAY EMISSION RATES IN THE HARTREE–SLATER APPROXIMATION. Manson, S. T. (Georgia State Univ., Atlanta); Kennedy, D. J. At. Data Nucl. Data Tables; 14: No. 2, 111-120 (Aug 1974).

X-ray emission rates for the filling of inner-shell vacancies were calculated for all elements from Z = 6 to Z = 100 with nonrelativistic Hartree–Slater wave functions. Results are presented for all shells, K, L, ... Q, for electric dipole transitions only. (auth)

1662 EXPERIMENTAL K AND L RELATIVE X-RAY EMISSION RATES. Salem, S. I.; Panossian, S. L.; Krause, R. A. (California State Univ., Long Beach). At. Data Nucl. Data Tables; 14: No. 2, 91-109(Aug 1974).

Most probable values of K x-ray and L x-ray emission rates were determined by constructing least-squares computer fits to the available experimental points plotted against atomic number. The numerical values thus obtained are presented in four tables, one for the K-shell and one for each of the L-subshell transitions. Graphic presentations of the experimental points, the least-squares smooth curves, and the results of the recent calculations based on the relativistic Hartree–Slater potential are also included. (19 figures, 4 tables) (auth)

1663 STRONG PROCESSES AND TRANSIENT STATES. de Broglie, L. (Academie des Sciences, Paris). Found. Phys.; 4: No. 3, 321-333(Sep 1974).

Certain difficulties raised by Einstein and Schroedinger in connection with the quantum theory of radiation are discussed and resolved in terms of the theory of the double solution. (auth)

1664 POSITIONS AND STATE VECTORS OF LEVEL CROSSINGS. von Oppen, G. (Technische Univ., Berlin). Physica; 75: No. 1, 133-145(1974).

By discussing the level crossings (LC) of a hyperfine multiplet in external magnetic or electric fields, it is found that the theory of matrix pencils is an appropriate mathematical formalism for general investigations on LC phenomena. Magnetic (electric)-field position and state vectors of a hyperfine LC correspond to a latent root and a latent vector of a regular matrix pencil. The theory enables us to give a general account of the orthogonality relations introduced recently, to derive sum-rule like limitations of the amplitudes of LC signals, and to present a method for a straightforward calculation of positions and state vectors of LC's. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

Refer also to abstract 349.

1665 ASYMPTOTIC SOLUTION OF THE CAUCHY PROBLEM FOR A LINEARIZED SYSTEM OF EQUATIONS. Drozhzhinov, Yu. N. (Inst. of Mathematics, Moscow). Sov. Phys. - Dokl. (Engl. Transl.); 18: No. 10, 638-639(Apr 1974).

Translated from Dokl. Akad. Nauk SSSR; 212: No. 4, 831-833 (Oct 1973).

The behavior of the solution of the Cauchy problem for a linearized system of equations of magnetohydrodynamics is studied for large times. (MHR)

1666 STABILITY OF A CURRENT-CARRYING FLUID WITH A FREE SURFACE IN A TRANSVERSE MAGNETIC FIELD. Wang, C. (Department of Applied Mechanics and Engineering Science, The University of Michigan, Ann Arbor, Michigan 48104). Phys. Fluids 17: No. 6, 1177-1182 (June 1974).

The stability of a viscous, incompressible, electrically conducting fluid with a free surface in a transverse magnetic field is investigated. A horizontal layer of fluid is set in motion by the combined action of the horizontal electric current and a vertically imposed magnetic field. An eigenvalue problem is formulated for infinitesimal disturbances and is solved by the regular perturbation method. It is found that if the electromagnetic effects are sufficient to overcome the stabilizing effect of gravity, the flow is unstable. The instability is due to the stratification of electric conductivity and to the longitudinal Lorentz force. Topological features of the $(c_i)_t$ curves for various cases are depicted. The roles played by the electric current as well as the magnetic field on the stability of the flow system are discussed briefly. (auth)

1667 FREE CONVECTION EFFECTS ON HORIZONTAL MAGNETOHYDRODYNAMIC CHANNEL FLOW WITH VARIABLE VISCOSITY. Soundalgekar, V. M. (Indian Inst. of Tech., Bombay). Indian J. Phys.; 48: No. 5, 394-405(May 1974).

An analysis of MHD channel flow with heat transfer under the influence of the crossed fields, buoyancy forces and variable viscosity is carried out. Solutions for the velocity, current density, magnetic field temperature are derived and are shown graphically. The numerical values of the skin-friction and the Nusselt numbers are entered in tables. It is observed that in constant viscosity case, the skin-friction and Nu increase with more heating of the channel plates and decrease with more heating of the channel plates and decrease with more cooling of the channel plates. In case of variable viscosity, with more cooling of the plates, there is a tendency of separation at the lower plate. In the presence of buoyancy forces, the skin-friction decreases. In an MHD generator, an increase in the loading parameter or due to more heating of the plates, the skin-friction increases. (auth)

1668 EQUATIONS OF BOUNDARY LAYER IN ASYMMETRIC MAGNETOHYDRODYNAMICS. Petrosyan, L. G. (Erevan State Univ.). Izv. Akad. Nauk Arm. SSR, Ser. Mekh.; 25: No. 6, 50-60(1972). (In Russian).

The basic equations of asymmetric magnetohydrodynamics are presented. The equations of motion of incompressible electroconductive fluid of high or infinite electroconductivity are derived. Various types of equations of the plane boundary layer for the fluid of high or infinite as well as of low electroconductivity are considered. The solution for the problem of flow around the plane plate by viscous incompressible fluid with angular stresses is given. (auth)

1669 SYSTEM OF EQUATIONS FOR A MAGNETOHYDRODYNAMIC BOUNDARY LAYER. Suslov, A. I. Vestn. Mosk. Univ., Ser. I, Mat., Mekh.; 29: 62-70(1974). (In Russian).

Consideration of a system of equations describing the steady plane-parallel boundary layer of a conducting fluid in the presence of magnetic and electric fields. The laminar surface is considered to be isolated, the magnetic Reynolds number is less than or about one, and the conductivity of the fluid is constant. Existence and uniqueness theorems are proved, and the effect of fluid suction is considered. (IAA)

1670 VISCOUS MFD LOW HARTMANN FLOW IN AN ANNULAR GAP: A MAGNETIC PRANDTL NUMBER EXPANSION. Matalon, M.; Schweitzer, S. (Tel Aviv Univ., Israel). J. Franklin Inst.; 297: 259-285(Apr 1974).

The problem of a liquid conductor confined between two concentric cylindrical electrodes and driven electromagnetically is considered. The steady, three-dimensional viscous case is treated asymptotically in the limit of small magnetic Prandtl numbers. The zero-order solution to the coupled hydrodynamic and Maxwell equations yields the trivial solution of no motion in the limit of vanishing conductivity. Results for the first-order solution indicate two-dimensional effects in the electromagnetic field quantities while the first-order velocity is one-dimensional in the circumferential direction. Due to secular effects the solution is limited to values of small Hartmann numbers. The formulation of the second order and a limited solution for the velocity distribution indicates that the velocity field is three-dimensional having a cell-type structure. (auth)

1671 AXISYMMETRIC MAGNETOGASDYNAMIC FLOWS. Colwell, D. J. (North Staffordshire Polytechnic, Stafford, Eng.). Z. Angew. Math. Phys.; 25: 55-62(25 Jan 1974).

Results obtained by Chandrasekhar (1956), in which equations governing axisymmetric magnetohydrodynamic flows with infinite conductivity are reduced to azimuth-independent form, are generalized. Using a technique similar to that used by Kingston and Rodgers (1971) for unsteady, plane, magnetogasdynamic flows, an interesting example of a nonsteady, axisymmetric, magnetogasdynamic flow is deduced. (IAA)

1672 ANALOGY BETWEEN THE TRANSITION TO TWO-DIMENSIONAL TURBULENCE AND ORIENTED MAGNETIZATION. Yantovskii, E. I. Magn. Gidrodin.; No. 2, 135-138(1974). (In Russian).

Independent measurements have confirmed quantitatively and qualitatively the hypothesis on the transition of three-dimensional turbulence to two-dimensional during the flow of a conducting fluid in channels in a strong transverse magnetic field. However questions on the dynamics of this transformation and on the possibility of calculating the transition from the increase of the field remain unanswered. A physical analogy between the transition to two-dimensional turbulence and oriented magnetization is proposed which makes it possible to answer approximately (in the two usual semiempirical theories of turbulence) these questions. (JSR)

1673 CALCULATION OF THE BOUNDARY LAYER AT A POROUS PLATE WITH VARIABLE PUMPING OF A MAGNETIC FIELD. Kereselidze, Z. A.; Sharikadze, D. V. Magn. Gidrodin.; No. 2, 138-140(1974). (In Russian).

In the region of small Reynolds magnetic numbers $Re_m \ll 1$, the problem of the non-stationary boundary layer was solved for the particular cases of values of the pumping rate. The steady flow around the plate during random pumping rate was examined and a comparison was made of the boundary layer in the general and magnetohydrodynamic cases. The effect of the magnetic field leads to a decrease of the boundary layer and a flattening of its profile. (tr-auth)

1674 BOUNDARY LAYER ON A LONGITUDINALLY STREAMLINED ELONGATED CYLINDER IN A RADIAL MAGNETIC FIELD. Derkach, P. Kh.; Zhigula, T. I. Magn. Gidrodin.; No. 2, 141-142(1974). (In Russian).

Formulas were derived for the velocity profile of the longitudinal flow around a greatly elongated cylinder by a homogeneous conducting fluid in a radial magnetic field. The formulas obtained were solved numerically on the Minsk-22 computer and velocity profiles are shown on three different values of a constant. (JSR)

1675 LOW-INTENSITY SHOCK WAVES IN A MAGNETIZING MEDIUM. Tarapov, I. E. Magn. Gidrodin.; No. 2, 47-50(1974). (In Russian).

The low-intensity shock waves in a medium which can be isotropically magnetized by an external magnetic field were examined. It was shown that these waves can be both compression shock and expansion shock waves. (tr-auth)

1676 PROPAGATION OF TRAVELING WAVES IN LIQUID ELECTROCONDUCTING WAVEGUIDES, CONFINED BY ELASTIC DIELECTRICS. Selezov, I. T.; Selezova, L. V. Magn. Gidrodin.; No. 2, 41-46(1974). (In Russian).

A solution was given to the problem of the propagation of magnetoacoustic traveling waves in an ideally conducting circular cylinder with external non-conducting elastic medium under the effects of a strongly azimuthal magnetic field. The external medium was described by linearized magnetohydrodynamic equations with zero unperturbed velocity. In the external medium the unrelated equations of the linear theory of elasticity and the Maxwell equations were valid. All fields are interrelated because of the Lorentz force and the coupling conditions on the boundary line. Solutions were constructed for two field functions and from the coupling conditions dispersion equations were introduced which were studied asymptotically in the long-wave and short-wave

approximations. It was established that with increase of the magnetic field the velocities of the magnetoacoustic wave and the signal delay were increased. (tr-auth)

1677 QUASI ONE-DIMENSIONAL DESCRIPTION OF OHM'S LAW IN MAGNETOHYDRODYNAMICS. Pleshanov, A. S. Magn. Gidrodin.; No. 2, 73-76(1974). (In Russian).

It was shown that the quasi one-dimensional description of Ohm's law leads to anisotropy of the MHD characteristics in planes perpendicular to a magnetic field. Independent of the profile of all values across the channel, it is possible to draw a series of conclusions on the relation between different MHD characteristics during different averaging methods. (tr-auth)

1678 RAYLEIGH-TAYLOR INSTABILITY CAUSED BY ELECTROMAGNETIC FORCES. Khait, V. D. Magn. Gidrodin.; No. 2, 69-72(1974). (In Russian).

The magnetohydrodynamic instability, analogous to the instability of heavy liquids, located above very light liquids, was examined. When there are two media with different conductivities and with an electric current crossed by a magnetic field, the electromagnetic force $j \times B$ under given conditions has the effect of gravity. The study was made in the framework of magnetohydrodynamics in the galvanic approximation without consideration of the dissipative processes. The Hall effect was considered and it was assumed that the media differ not only by the values of the electroconductivity but also by the Hall density and parameters. A precise solution of the magnetohydrodynamic equation gives the dependence of the frequency of the oscillation on the wave number k. The frequency can become a purely imaginary value which implies instability of the division line. (tr-auth)

1679 SOLUTION OF A MAGNETOHYDRODYNAMIC BOUNDARY PROBLEM WITH PERIODIC BOUNDARY CONDITIONS. Malov, Yu. I.; Martinson, L. K.; Pavlov, K. B. Magn. Gidrodin.; No. 2, 63-68(1974). (In Russian).

The steady flow of a viscous incompressible isotropically conducting fluid in two-dimensional channels was examined. The conductivity of the channel walls is a random periodic function. The solution of the problem was constructed in the form of an expansion in trigonometric series with coefficients satisfying the infinite linear algebraic system. A justification of the reduction for solution of this system was given. The results of calculations for channels with walls of periodically alternating sections with different conductivity were given. The effect of the conductivity of the corresponding sections of the channel walls on the velocity u of the fluid was established. The dependence of the value $\delta = u_{max} - u_{min}$ on the periodicity parameters was shown. (tr-auth)

1680 MAGNETOHYDRODYNAMIC DISPLACEMENT FLOWS OF LIQUIDS WITH POWER RHEOLOGICAL LAW UNDER CONDITIONS OF TRANSVERSE DRIFT. Golaido, S. I.; Martinson, L. K.; Pavlov, K. B. Magn. Gidrodin.; No. 2, 58-62(1974). (In Russian).

Magnetohydrodynamic displacement flows of non-Newtonian dilatant liquids with transverse velocity components were examined. The combined effect of the magnetic field and the transverse drift on the rate of movement of the displaced wave front was studied on examples of a precise analytical solution and a solution obtained by numerical methods. (tr-auth)

1681 ONE LOITSYANSKII-TYPE INVARIANT IN MAGNETOHYDRODYNAMICS. Tseskis, A. L. Magn. Gidrodin.; No. 2, 133-135(1974). (In Russian).

It was shown that during homogeneous and isotropic turbulent motion of conducting fluids Loitsyanskii-type invariant for the magnetic field is equal to 0. (tr-auth)

1682 MOMENTS AFFECTING THE SIDE SURFACES OF A HOLLOW CYLINDER ROTATING IN A CONDUCTING FLUID IN AN AXIAL MAGNETIC FIELD. Kuznetsov, S. E.; Andreev, V. I. Magn. Gidrodin.; No. 2, 108-112(1974). (In Russian).

During the steady rotation of a hollow cylinder in the turbulent flow of a conducting fluid, it was proposed by analogy with laminar flow to calculate the moments acting on the sides of the cylinder by use of the principle of the separate determination of the usual hydrodynamic moments and moments arising because of the effect of the electromagnetic force in the fluid. The calculated data agreed satisfactorily with the experimental data. (tr-auth)

1683 DEGENERATION OF HOMOGENEOUS MHD TURBULENCE. Genin, L. G.; Manchkha, S. P.; Sviridov, V. G. Magn. Gidrodin.; No. 2, 87-93(1974). (In Russian).

The equations for the energy balance of turbulent velocity fields and pulsating magnetic fields were obtained. An analysis was made of the physical meaning of the individual terms of these equations and a scheme, graphically illustrating the energy exchange between the individual components of the pulsation of the velocity and the magnetic field and the dissipation of energy into heat in the process of degeneration of MHD turbulence, was constructed. The equations for the energy balance made it possible to explain the physical meaning of the hypothesis used during the analysis of degeneration processes and to evaluate the degree of reliability of the results obtained on this basis. (tr-auth)

1684 SYMMETRIC FORM OF THE MAGNETOHYDRODYNAMIC EQUATION. Godunov, S. K. (Computer Center, Novosibirsk, USSR). Chislennye Metody Mekh. Sploshnoi Sredy; 3: No. 1, 26-34(1972). (In Russian).

An earlier study of symmetric hyperbolic systems was broadened to cover a wider class of equations, deriving a novel form for the magnetohydrodynamic equation. The outstanding feature of the symmetrization of the magnetohydrodynamic equations was the breakdown of the non-divergent character of the original equations. (TTT)

1685 BUOYANCY OF GAS BUBBLES IN A LONGITUDINAL MAGNETIC FIELD. Kapustyanenko, G. G. Magn. Gidrodin.; No. 2, 143-145(1974). (In Russian).

It was established that the Froude number for gaseous bubbles, rising to the top in vertical tubes, filling an electroconducting fluid and placed in a longitudinal magnetic field, varies from 0.38 ± 0.01 to 0.54 ± 0.01 during change of the Stewart number from 0 to 7. This results were valid for fairly large tube diameters which the force of the surface tension at the boundary of the fluid and gas is small. (tr-auth)

1686 UNIVERSAL STABILITY OF MAGNETOACOUSTIC MODES. Krueger, J. G. (Ghent Rijksuniversiteit (Belgium). Seminarie voor Wiskundige Natuurkunde). Physica; 75: No. 1, 198-201(1 Jul 1974).

The concept of mode is generalized for nonhomogeneous systems. Within the framework of magnetohydrodynamics (MHD), it is shown that for an arbitrary nonhomogeneous fluid, two generalized magnetoacoustic modes are always stable while the unstable displacements are reserved for the third mode. (auth)

PHYSICS (HIGH-ENERGY)

1687 WHAT IS HIGH ENERGY. Touschek, B. (Garvens, s.p.A., Rome, Piazza d'Indipendenza, Italy). Phys. Lett., B; 51: No. 2, 184-186(22 Jul 1974).

The energy region above 1 GeV is subjected to a search for characteristic points. These points exist, their significance is discussed. A strange and unlikely correlation between them and the masses of lower energy physics is pointed out. (auth)

Particle Interactions and Properties (Experimental)

Refer also to abstract 1771.

1688 (UCLA-10-P-17X3) RESEARCH IN HIGH ENERGY PHYSICS. Drickey, D. J.; Stork, D. H.; Ticho, H. K. (California Univ., Los Angeles (USA)). 1974. Contract AT(11-1)-Gen-10. 41p. Dep. NTIS $5.25.

This contract renewal proposal summarizes work accomplished on this contract during the period of October 1973 to October 1974 and outlines plans in each of the experimental areas of interest of the group. In addition the Southern California Film Measuring Center activities, which include completion of the MOLLY project and the start of production measurements on MOLLY, are summarized. This year has been a very active one, and has led to completion of four experiments: the Serpukhov pion-electron and pion-proton scattering experiments, the Berkeley χ^0 experiment and the SLAC K_{L_3} experiment. One major experiment was performed a baryon exchange experiment in the 40'' rapid cycling chamber at SLAC, and this has represented the major effort for this contract year. In addition, equipment was built for and installation begun of the NAL pion-electron scattering experiment and this experiment will run as the major effort in the coming contract year. Prototype development of chambers for the N experiment at SPEAR was started this year; it is expected to construct this equipment during the coming contract year. Long range plans call for a continuation of our effort along the same lines in the past with major emphasis being directed toward experiments at SLAC and especially toward SPEAR. The interest of the group in e^+-e^- storage ring physics is very high and it is hoped to focus effort in this field. The N experiment provides one such focus; others are anticipated in the future. It is planned to make major contributions of time and effort to the planning of PEP and especially to the design of interaction areas. Simultaneously, it is planned to carry through to completion the investigation of pion and hadron electromagnetic form factors at NAL, but view this effort as an experiment rather than a programmatic study. (JFP)

1689 HIGH ENERGY PHYSICS INDEX. Volume 12, No. 18, 1974. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). 88p.

1690 NEW DEVELOPMENTS IN HIGH ENERGY PHYSICS. Skarek, P. (European Organization for Nuclear Research, Geneva (Switzerland)). Umsch. Wiss. Tech.; 74: No. 15, 481-483(Aug 1974). (In German).

1 fig.; 3 refs.

This review article is a shortened translation of a plenary talk given by L. van Hove at the 2nd General Conference of the European Physical Society in 1972 and covers the progress in the last three years concerning renormalization theory, violation of time reversal invariance, granular structure of the proton, hadron collisions, and the propagation of hadronic systems through nuclear matter. A few words on newest results—where appropriate—have been added. (auth)

Electromagnetic

1691 (DESY-74/32) ELECTROEXCITATION OF NUCLEON RESONANCES ON PROTONS AND NEUTRONS. Koebberling, M.; Moritz, J.; Schmidt, K. H.; Wegener, D.; Zeller, D.; Bleckwenn, J.; Heimlich, F. H. (Deutsches ElektronenSynchrotron (DESY), Hamburg (F. R. Germany)). Jul 1974. 26p. Dep. NTIS (US Sales Only) $4.50.

New data for the total absorption cross section of virtual photons on protons and deuterons are used to determine the excitation cross section of the three dominant nucleon resonances at W = 1236 MeV, W = 1520 MeV and W = 1685 MeV. The q^2-dependence of the excitation on protons and of the ratio for the excitation on deuterons and protons is given. The results are compared with the predictions of the symmetric quark model. (auth)

1692 (DESY-74/40) $\Delta^{++}\pi^-$-ELECTROPRODUCTION NEAR THRESHOLD AND THE Q^2 DEPENDENCE OF THE CONTACT INTERACTION. Joos, P.; Ladage, A.; Meyer, H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Aug 1974. 11p. Dep. NTIS (US Sales Only) $4.00.

The Q^2 dependence of $\sigma(\gamma_V p \to \pi^-\Delta^{++})$ was measured. Close to threshold $\sigma(\gamma_V p \to \pi^-\Delta^{++})$ is roughly proportional to $1/(m_\rho^2 + Q^2)^2$. The data are consistent with dominance of the contact term and imply that the contact term has the Q^2 dependence of the ρ propagator. (auth)

1693 (DESY-F-1-73/1) PHOTOPRODUCTION OF $\Delta(1236)$ AND OF RHO-MINUS IN THE REACTION $\gamma n \to \pi^-{}^0 p$ WITH PHOTON ENERGIES UP TO 5.5 GeV. Storim, F. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Feb 1973. (In German).

Thesis.

The cross sections for the processes $\gamma n \to \pi^-\pi^0 p$, $\gamma n \to \pi^-\Delta^+(1236)$, and $\gamma n \to \pi^0\Delta^0(1236)$, and $\gamma n \to \rho^- p$ are presented as functions of the photon energy. For resonance production, the differential cross sections are given for various intervals of photon energy. These analyses are based on a sample of about 5000 $\gamma n \to \pi^-\pi^0 p$ events. The extraction of cross sections on neutrons from the deuteron data and the separation of multi-π^0 events is discussed in detail. The photoproduction of Δ isobars and vector mesons is discussed in terms of several models. (GE)

1694 THEORETICAL AND EXPERIMENTAL COMPTON SCATTERING CROSS SECTIONS AT 1.12 MeV IN THE CASE OF STRONGLY BOUND K-SHELL ELECTRONS. Baba Prasad, P. N.; Kane, P. P. (Indian Inst. of Tech., Bombay). J. Res. Nat. Bur. Stand.; 78A: No. 4, 461-463(1974).

Measurements are reported for the differential cross sections for Compton scattering of 1.12 MeV gamma rays by the K-shell electrons of tin, tantalum, gold, and thorium. A few discrepancies between approximate theoretical calculations and the experimental results for different energies are pointed out. The need for an exact relativistic calculation is indicated. (auth)

1695 A SEARCH FOR B AND $\rho'(1250)$ PRODUCTION IN THE REACTION $\gamma p \to p\pi^+\pi^-$ + NEUTRALS AT 2.8, 4.7 AND 9.3 GeV. Ballam, J.; Chadwick, G. B.; Eisenberg, Y.; Kogan, E.; Moffeit, K. C.; Skillicorn, I. O.; Spitzer, H.; Wolf, G. (Stanford Linear Accelerator Center, Calif. (USA)); Bingham, H. H.; Fretter, W. B. Nucl. Phys., B; 76: No. 3, 375-399(18 Jul 1974).

The reaction $\gamma p \to p\pi^+\pi^-$ + neutrals has been studied in the LBL-SLAC 82'' hydrogen bubble chamber exposed to a linearly polarized photon beam at 2.8, 4.7 and 9.3 GeV. An enhancement is observed at 1.24 GeV in the mesonic mass recoiling against the proton. The enhancement is produced peripherally with slopes of 5-7 GeV^{-2} and cross sections of 1-3 μb. It is shown that $\omega\pi^0$ is likely to be the major decay mode and upper limits are given for other decay modes. The enhancement can be either the $J^P = 1^+$ B meson, a yet unestablished $J^P = 1^-$ meson decaying via $\omega\pi^0$, or a diffractively produced Deck-type background. The observed decay correlations are compatible with an s-channel helicity conserving production process. The data at higher masses are consistent with a $\rho\epsilon$ decay of the $\rho'(1600)$ and an upper limit of 4 ± 1 μb is obtained for $\rho'(1600)$ production in the final state $p\pi^+\pi^-$ + neutrals at 9.3 GeV. (auth)

1696 THE ENERGY DEPENDENCE OF $\sigma(e^+e^- \to \text{HADRONS})$ IN THE TOTAL CENTRE-OF-MASS ENERGY RANGE 1.2 TO 3.0 GeV. Bernardini, M.; Bollini, D.; Brunini, P. L.; Fiorentino, E.; Massam, T.; Monari, L.; Palmonari, F.; Rimondi, F.; Zichichi, A. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Lett., B; 51: No. 2, 200-204(22 Jul 1974).

1085 events of the type $e^+e^- \to$ hadrons have been observed in the total center-of-mass energy range $\sqrt{s}$ = 1.2 to 3.0 GeV. The energy dependence of the total annihilation cross section, parametrized in the form $\sigma(e^+e^- \to \text{hadrons}) = A \cdot s^n$, is measured to be $n = -(1.54^{+0.5}_{-0.5}{}^{+0.1}_{-0.1})$ in the above energy range. (auth)

1697 DEUTERON POLARIZATION IN e-d SCATTERING. Brady, T. J. (Univ. of Saskatchewan, Saskatoon); Tomusiak, E. L.; Levinger, J. S. Can. J. Phys.; 52: No. 14, 1322-1330(15 Jul 1974).

The tensor polarization of the deuteron in elastic electron-deuteron scattering depends on the ratio of deuteron quadrupole and monopole form factors. Measurements at $q \simeq 1$ fm^{-1} are sensitive to the deuteron percentage D state; while measurements at $q \simeq 5$

fm^{-1} are sensitive to a diffraction minimum in the monopole form factor. (auth)

1698 EXPERIMENTAL TEST OF QUANTUM ELECTRODYNAMICS FOR THE REACTION $e^+e^- \rightarrow \gamma\gamma$ AT 5 GeV CENTER-OF-MASS ENERGY. Law, M. E.; Eshelman, J.; Leong, J.; Litke, A.; Little, R.; Newman, H.; Strauck, K.; Tarnopolsky, G.; Wilson, R. (Cambridge Electron Accelerator, MA). Contracts AT(11-1)-3063; AT(11-1)-3064; AT(11-1)-3069. Lett. Nuovo Cim.; 11: No. 1, 5-8(7 Sep 1974).

The cross section for the reaction $e^+e^- \rightarrow \gamma\gamma$ was measured at 5 GeV over the range of production angles from 53° to 127°, and was found to be consistent with the QED prediction. (LBS)

1699 OBSERVATION OF THE REACTIONS $e^+e^- \rightarrow e^+e^-$, $e^+e^- \rightarrow \gamma\gamma$, AND $e^+e^- \rightarrow \mu^+\mu^-$ AT A CENTER-OF-MASS ENERGY OF 5.2 GeV. Beron, B.L.; Crawford, J.F.; Ford, R.L.; Hofstadter, R.; Hughes, E.B.; Kose, R.; LeCoultre, P.; Martin, T.W.; O'Neill, L.H.; Rand, R.E.; Resvanis, L.; Schilling, R.F.; Simpson, J.W. (High Energy Physics Laboratory and Department of Physics, Stanford University, Stanford, California 94305). Phys. Rev. Lett. 33: No. 11, 663-666 (9 Sept 1974).

We report measurements if $e^+e^- \rightarrow e^+e^-$, $e^+e^- \rightarrow \gamma\gamma$, and $e^+e^- \rightarrow \mu^+\mu^-$ at angles close to 90°, relative to Bhabha scattering at 3.7°, at a center-of-mass energy equal to 5.2 GeV. The results are found to be consistent with the predictions of quantum electrodynamics. (auth)

1700 INCLUSIVE π^0 AND η PHOTOPRODUCTION AT HIGH TRANSVERSE MOMENTA. Eisner, A.M.; Caldwell, D.O.; Cumalat, J.P.; Kendall, B.N.; McPharlin, T.P.; Morrison, R.J.; Murphy, F.V. (Department of Physics, University of California, Santa Barbara, California 93106). Phys. Rev. Lett. 33: No. 14, 865-868 (30 Sept 1974).

We report measurements of inclusive π^0 and η production from 21-GeV bremsstrahlung on protons, at p_T between 1 and 2 GeV/c. The π^0 cross section is reasonably well described by a single term of the constituent-interchange model, involving the irreducible subprocess $\bar{q}p \rightarrow qq\pi$. The π^0/π^+ ratio is approximately 0.8 throughout our kinematic region. The η/π^0 ratio averages 0.53 ± 0.17. (auth)

1701 MEASUREMENTS OF INELASTIC COMPTON SCATTERING. Caldwell, D.O.; Eisner, A.M.; Elings, V.B.; Kendall, B.N.; McPharlin, T.P.; Morrison, R.J.; Murphy, F.V.; Worster, B.W. (Department of Physics, University of California, Santa Barbara, California 93106). Phys. Rev. Lett. 33: No. 14, 868-871 (30 Sept 1974).

We have measured inelastic Compton scattering of 21-GeV bremmstrahlung photons on protons, for p_T above 1 GeV/c. The yield of photons after subtracting π^0 and η decay contributions appears to be nonhadronic and is greater than parton-model predictions for integer-charged partons. The constituent-interchange model provides a possible explanation. (auth)

1702 MEASUREMENTS OF THE MAGNETIC DIPOLE MOMENTS OF THE ANTIPROTON AND THE Σ^- HYPERON. Roberts, B. L. Williamsburg, VA; Coll. of William and Mary (1974). 71p. University Microfilms Order No. 74-22,288.

Thesis (Ph. D.).

The fine-structure splittings in atoms formed by antiprotons in lead and uranium and Σ^- hyperons in lead and platinum were measured. Since the fine structure is produced through the interaction of the magnetic dipole moment of the antiproton or the Σ^- hyperon with the Coulomb field of the nucleus, a value for the magnetic moment can be determined from the splitting. The magnetic moment obtained for the antiproton was (-2.819 ± 0.056) nuclear magnetons which agrees well with the CPT prediction of -2.793 nuclear magnetons. The magnetic moment derived for the Σ^- hyperon was (-1.48 ± 0.37) nuclear magnetons which is in agreement with the sign given by simple SU(3) theory, but differs somewhat from the value of -0.9 nuclear magnetons predicted by the theory with no mass breaking. (Diss. Abstr. Int., B)

1703 THE RATIO OF DEEP-INELASTIC e-n TO e-p CROSS SECTIONS IN THE THRESHOLD REGION. Bodek, A.; Dubin, D. L.; Elias, J. E.; Friedman, J. I.; Kendall, H. W.; Poucher, J. S.; Riordan, E. M.; Sogard, M. R. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Physics); Coward, D. H.; Sherden, D. J. (Stanford Linear Accelerator Center, Calif. (USA)). Phys. Lett., B; 51: No. 4, 417-420(19 Aug 1974).

Measurements of the ratio of the deep-inelastic electron-neutron to electron-proton differential cross sections in the threshold ($\omega < 3$) region are reported. The ratio was found to scale and to decrease monotonically with decreasing ω. No violation of the quark model lower bound of 0.25 was observed in the ratio. (auth)

1704 RECOIL PROTON POLARIZATION IN π^- PHOTOPRODUCTION FROM DEUTERIUM BETWEEN 450 AND 950 MeV AND A PARTIAL WAVE ANALYSIS OF $\gamma n \rightarrow \pi^- p$ IN THE RESONANCE REGION. Metcalf, W. J. Pasadena, CA; California Inst. of Tech. (1974). 183p. University Microfilms Order No. 74-21,602.

Thesis (Ph. D.).

In an experiment performed at the Caltech synchrotron the recoil proton polarization in the reaction $\gamma n \rightarrow \pi^- p$ was measured at cm pion angles of 90 and 120° in the region from 450 to 900 MeV in lab photon energy. A deuterium target was used and the observed reaction $\gamma d \rightarrow \pi^- pp$ was related to $\gamma n \rightarrow \pi^- p$ by a simple spectator model. The polarization was determined from the distribution in the azimuthal scattering angle, ϕ, of the recoil protons from carbon in a range-scattering chamber consisting of alternate spark gaps and carbon plates. A maximum likelihood method was used to extract the polarization from the observed ϕ distribution of the p-C scatters. The π^- coincident with the recoil proton was detected in a magnetic spectrometer where its momentum was quite accurately determined. Background contamination was less than 2% and the inelasticity of the p-C scatters was included in the calculation of the carbon analyzing power. However, the uncertainty in this inelasticity was the primary source of systematic error. The resulting polarizations were fit, along with other data on the reaction $\gamma n \rightarrow \pi^- p$, using a resonance-background model of pion photoproduction in order to determine the couplings of many $I = \frac{1}{2}$ nucleon isobars to this reaction. These couplings, several of which are better determined than in previous studies, are compared to quark model predictions. The quark model is found to give a very good description of many of these couplings. (Diss. Abstr. Int., B)

Weak

1705 (CEA-N-1702) EXPERIMENTAL STUDY OF THREE BODY DECAY OF THE $K^0-\bar{K}^0$ SYSTEM. Burgun, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires). Mar 1974. 139p. (In French). Dep. NTIS (US Sales Only) $9.75.

Thesis.

Certain rules concerning the theory of weak interactions are investigated, using different 3-body decay channels of the $K^0-\bar{K}^0$ system observed in a hydrogen bubble chamber. The $K^0 \rightarrow \pi^+\pi^-\pi^0$ channel allows a measurement of possible CP violation in this decay mode. The parameter η_{+0} is found to be compatible with 0, so there is no evidence of CP violation in this channel. The analysis of the decay mode $K^0 \rightarrow \pi^{\pm} l^{\pm} \nu$ (where l is a lepton) gives information on the $\Delta S = \Delta Q$ rule. The measurement of the violation parameter χ_l shows no indication of violation of the $\Delta S = \Delta Q$ rule, or of CP, for electrons or for muons. Finally, the decay mode $K^0 \rightarrow \pi^+\pi^-\gamma$ is found to be dominated by internal bremsstrahlung. (auth)

1706 RESULTS OF THE NEUTRAL CURRENT SEARCH IN GARGAMELLE. Morfin, J. G. (Technische Hochschule, Aachen). ATOMKI (At. Kut. Intez.) Kozlem., Suppl.; 16: No. 2, 11-41(1974).

A brief introduction to the theory of Salam and Ward [Phys. Lett., 13, 168 (1964)] and Weinberg [PRL, 19, 1264 (1967) and PR D5] requiring the existence of neutral currents in the unification of weak and electromagnetic phenomena is given first. The experimental configuration is described, and then the experimental results are discussed from the point of view of purely leptonic neutral currents: the events were divided into neutral-current candidates (NC), charged-current candidates (CC), and associated events. The final results were $NC/CC\ (\nu) = 0.23 \pm 0.03$ and $NC/CC\ (\bar{\nu}) = 0.46 \pm 0.09$. Various interpretations of these results are explained. (10 figures, 2 tables) (RWR)

1707 EXPERIMENTAL RESULTS OBTAINED IN THE SEARCH FOR NEUTRAL CURRENTS. Musset, P. (CERN, Geneva). J. Phys. (Paris), Colloq.; No. 3, 1-7 (1973). (In French).

From Centenary congress of the French Physical Society; Vittel, France (28 May 1973).

The experimental results of the searches for neutral currents in leptonic interactions of neutrinos, semi-leptonic interactions of neutrinos, and strangeness changing weak interactions are reviewed. The results concerning neutrino interactions are compared with the predictions of the Salam-Weinberg theory. (auth)

1708 SCALING-VARIABLE DISTRIBUTIONS IN HIGH-ENERGY INELASTIC NEUTRINO INTERACTIONS. Aubert, B.; Benvenuti, A.; Cline, D.; Ford, W.T.; Imlay, R.; Ling, T.Y.; Mann, A.K.; Messing, F.; Pilcher, J.; Reeder, D.D.; Rubbia, C.; Stefanski, R.; Sulak, L. (Department of Physics, Harvard University,

Cambridge, Massachusetts 02138). Phys. Rev. Lett. 33: No. 16, 984-987 (14 Oct 1974).

We present measured distributions in the scaling variables x and y obtained from the reactions $\nu_\mu(\bar{\nu}_\mu)$ + nucleon → $\mu^-(\mu^+)$ + hadrons at high energy. The x distributions are consistent with scale invariance. The x and y distributions are used to perform the first test of charge–symmetry invariance in high–energy neutrino interactions, assuming the validity of scale invariance. A possible effective deviation from charge–symmetry invariance is observed, which could be the result of new particle production. (auth)

Strong (Baryon-induced)

Refer also to abstracts 1924 and 2002.

1709 (CONF-740667-1) INCLUSIVE SINGLE-PARTICLE DISTRIBUTIONS IN $\bar{p}p$ INTERACTIONS AT 14.75 GeV/c. Dao, F. T.; Lach, J.; Whitmore, J. (National Accelerator Lab., Batavia, Ill. (USA)). Jul 1974. 22p. Dep. NTIS $4.25.

From international conference on antinucleon-nucleon interactions; Liblice, Czechoslovakia (23 Jun 1974).

Some preliminary results from an analysis of $\bar{p}p$ interactions at 14.75 GeV/c are presented. Charged and neutral particle production, model-independent comparisons with high energy pp interactions, and π^0 and total particle multiplicity distributions are considered. Various multiplicities, cross sections, distributions, and the KNO scaling are discussed. (JFP)

1710 (JINR-D-6004, pp 117-136) ELASTIC PROTON–NEUTRON SCATTERING BY MEANS OF PROTON–DEUTERON SCATTERING AT 24.0 GeV/c. Amaldi, U. (Istituto Superiore di Sanita, Rome); Biancastelli, R.; Bosio, C. 1972.

From international seminar on binary reactions of hadrons at high energies; Dubna, USSR (3 Jun 1971).

Measurements of proton–deuteron scattering have been performed using an incident 24.0 GeV/c proton beam. Momentum-loss spectra of forward-scattered protons were measured by a single-arm spectrometer over a range of proton angles from 13.5 to 107.0 mr. The contributions to the proton spectra of single and double scattering can be separated experimentally, thus allowing estimates of proton–neutron elastic cross sections to be deduced from the data over a range of four-momentum transfer squared, $|t|$, from 0.1 to 5.8 GeV^2. Coincidence measurements of elastic p-d scattering over a range of $|t|$ from 0.6 to 1.8 GeV^2 are also reported. (auth)

1711 (JINR-D-6004, pp 307-323) COMPARISON OF MOMENTUM SPECTRA OF SECONDARY PARTICLES PRODUCED IN 14.25, 19.2, AND 24.0 GeV/c p–p COLLISIONS. Allaby, J. V.; Diddens, A. N.; Dobinson, R. W. (CERN, Geneva). 1972.

From international seminar on binary reactions of hadrons at high energies; Dubna, USSR (3 Jun 1971).

Results are reported of a measurement of π^+, π^- and p yields in pp collisions at 14.25, 19.2 and 24.0 GeV/c for secondary momenta above 4 GeV/c and laboratory angles between 10.5 and 25 mrad. The data provide further information on scaling and the approach to limiting distributions in the 10–30 GeV energy range. Structure, which has been observed in the π^+ momentum spectrum, is discussed. (auth)

1712 (KHFTI-73-10, pp 74-76) INVESTIGATION OF dp → ppn REACTION AT 3.3 GeV/c. Glagolev, V. V. (Joint Inst. for Nuclear Research, Dubna, USSR); Lebedev, R. M.; Saitov, I. S.; Strel'tsov, V. N.; Sharkhu, G.; Zelinski, P.; Nioradze, M. S.; Sandach, A. 1973. (In Russian).

Preliminary results on the study of the dp → ppn reaction during the irradiation of the 100-cm hydrogen bubble chamber with a deuteron beam at 3.33 GeV/c were reported. A two-dimensional representation was obtained for the neutron momentum as a function of the proton momentum. The dependence of the transverse momentum on the longitudinal momentum was also obtained for neutrons (all dependences were in the system of the neutron at rest). The cross section of the dp → ppn channel was evaluated at 40.7 ± 1.2 mb. (INIS)

1713 (LBL-80) COMPILATION OF DATA ON INCLUSIVE REACTIONS. Law, M. E.; Kasman, J.; Panvini, R. S.; Sims, W. H.; Ludlam, T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1972. 630p. Dep. NTIS $34.50.

The data compilation on inclusive interactions covers spectra for pp, p–nucleus, $\bar{p}p$, K^+p, K^-p, π^+p, π^-p, ep, μp, and γp, also comparative plots and two-body correlations. The kinematics and phenomenology for inclusive spectra are also included. (JFP)

1714 (MPI-PAE-Exp.El.-29) STUDY OF CHARGE DISTRIBUTIONS IN INELASTIC PROTON–PROTON COLLISIONS. Idschok, U.; Kobe, P.; Selonke, F.; Wessels, B.; Blobel, V.; Fesefeldt, H.; Hellwig, B.; Moenkemeyer, D.; Benecke, J.; Breitenlohner, P. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (F. R. Germany)). May 1973. 38p.

Charge distributions for the secondaries from inelastic proton–proton collisions are studied by means of new data from an experiment at 12 and 24 GeV/c (2m HBC at CERN). By comparison with π^+p data at 16 GeV/c, the inclusive charge distributions for the fragments of an incident proton and pion, respectively, are analyzed. In addition, the cross sections for charge exchange between cms hemispheres are presented for the various charged-particle multiplicities. For events with no more than one neutral particle, charge and baryon exchange between cms hemispheres are compared to those between "clusters". For the inelastic two-prong reactions, the two-dimensional distributions in longitudinal phase space are presented. (GE)

1715 FRAGMENTATION CROSS SECTIONS OF 2.1-GeV/NUCLEON ^{12}C AND ^{16}O IONS. Cheshire, D. L. (Louisiana State Univ., Baton Rouge); Huggett, R. W.; Johnson, D. P.; Jones, W. V.; Rountree, S. P.; Verma, S. D.; Schmidt, W. K. H.; Kurz, R. J.; Bowen, T.; Krider, E. P. Phys. Rev., D; 10: No. 1, 25-31(1 Jul 1974).

A tungsten-scintillator ionization spectrometer (1000 g/cm^2 total depth) was exposed to 2.1-GeV/nucleon ^{12}C and ^{16}O ions at the Bevatron. Fragmentations of the incident ions could be observed in a five-layer CsI target (each layer 9 g/cm^2 thick) and in five tungsten–scintillator layers (each 13 g/cm^2 thick). The number of fragmentations in each of these layers was used to determine the total fragmentation cross sections. The Bradt–Peters overlap parameters are consistent with zero when calculated using these cross sections and a value of $r_0 = 1.25 \times 10^{-13}$ cm. (auth)

1716 AZIMUTHAL ANGULAR DISTRIBUTION OF SHOWER PARTICLES FORMED IN COLLISIONS OF HIGH-ENERGY PROTONS WITH HEAVY EMULSION NUCLEI. Azimov, S. A.; Abduzhamilov, Sh.; Aripov, R.; Gadzhieva, S. I.; Dzhuraev, M.; Igamberdiev, K. (Physical-Technical Inst., Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 4, 19-21(1974). (In Russian).

This study considers azimuthal correlations of shower particles generated by protons having a momentum of 67 GeV/c on interacting with heavy emulsion nuclei. A total of 198 stars on the emulsions were measured with the use of satisfactory selection criteria. Values for shower characteristics are presented. (SJR)

1717 COMPARISON OF THE ASSOCIATED MULTIPLICITY IN p + p → p + X REACTION AT 28.5 GeV/c WITH OTHER REACTIONS. Ochiai, F. (Himeji Inst. of Tech., Japan). Lett. Nuovo Cim.; 10: No. 18, 789-792(31 Aug 1974).

The mean charged-particle multiplicity $\langle n_{ch} \rangle$ was investigated as a function of four-momentum transfer t for four bands of missing mass M_x for the reaction pp → p X_n at 28.5 GeV/c. It is found that $\langle n_{ch} \rangle$ is practically independent of t in every M_x band. The results are compared with those of other groups and it is suggested that $\langle n_{ch} \rangle$ depends only on the available energy. (LBS)

1718 CORRELATIONS BETWEEN CHARGED PARTICLES EMITTED AT LARGE ANGLES IN HIGH ENERGY PROTON–PROTON COLLISIONS. British–Scandinavian ISR Collaboration. Lett. Nuovo Cim.; 11: No. 3, 173-176(21 Sep 1974).

Results are presented on measurements of correlations between charged particles emitted in the central region in pp collisions at two cm energies $\sqrt{s}$ = 23 GeV and $\sqrt{s}$ = 63 GeV at the CERN ISR. The normalized charge mutiplicities are shown. It is concluded that the dominant feature of the data—the linear increase with transverse momentum of the associated multiplicity opposite to the spectrometer particle—is probably of kinematic origin and due to conservation of transverse momentum inside the rapidity range covered by the experiment. (LBS)

1719 DIFFRACTION DISSOCIATION AND COULOMB DISSOCIATION OF HIGH-ENERGY NEUTRONS BY NUCLEI. O'Brien, D. D.; Longo, M. J.; Vandervelde, J. C. (Michigan Univ., Ann Arbor (USA)); Davis, M. B.; Kreisler, M. N. (Princeton Univ., N. J. (USA)). Nucl. Phys., B; 77: No. 1, 1-34(25 Jul 1974).

The results of a spark chamber experiment are presented in which the reaction n + A → (p + π^-) + A′ was studied, where the (pπ^-) pair is coherently produced off carbon, copper, and lead nuclei. Between 5000 and 55000 good events were collected with each target. Incident neutrons in the momentum range 10 to 28 GeV/c were used. Forward-going (pπ^-) pairs from the above reaction were detected in a wire spark chamber spectrometer which measured the momentum and angles of each

particle. The observation of a sharp forward peak (of width appropriate to the nuclear radius) indicated that a large fraction of the events were coherently produced. There is no evidence for any appreciable production of the well-established $I = \frac{1}{2}$ nucleon isobars; the limits appear to be inconsistent with estimates based on a straightforward extrapolation of pp data. The lead data show evidence for coulomb production of the Δ (1236). The carbon data indicate a spin $J > \frac{1}{2}$ for the coherently produced $(p\pi^-)$ states with pure $J = \frac{1}{2}$ possible. No firm conclusions can be drawn about helicity conservation. The Drell-Hiida-Deck model does not adequately fit the data, nor is the double-Regge-pole model completely satisfactory. (auth)

1720 PROTON-PROTON DIFFRACTION DISSOCIATION AT INCIDENT ENERGIES FROM 175 TO 400 GeV. Bartenev, V.; Kuznetsov, A.; Morozov, B.; Nikitin, V.; Pilipenko, Y.; Popov, V.; Zolin, L. (State Committee for Utilization of Atomic Energy of the USSR, Moscow, USSR); Carrigan, R.; Malamud, E.; Yamada, R. (National Accelerator Lab., Batavia, Ill. (USA)). Phys. Lett., B; 51: No. 3, 299-302(5 Aug 1974).

Differential cross sections $d^2\sigma/dtdM_X^2$ are presented for the inclusive reaction $p + p \rightarrow X$ in the range $0.01 < t < 0.05$ $(GeV/c)^2$, $1.3 < m_X^2 < 3.7$ GeV^2, and incident energies from 175 to 400 GeV. The results are compared with data in the 20 GeV energy region. (auth)

1721 MEASUREMENT OF $\pi^\pm$, $K^\pm$, p AND $\bar{p}$ PRODUCTION BY 200 AND 300 GeV/c PROTONS. Baker, W. F.; Eartly, D. P.; Giacommelli, G.; Koehler, P. F. M.; Pretzl, K. P.; Pruss, S. M.; Wehmann, A. A. (National Accelerator Lab., Batavia, Ill. (USA)); Carroll, A. S.; Chiang, I. H.; Kycia, T. F. Phys. Lett., B; 51: No. 3, 303-305(5 Aug 1974).

Data are presented on the yields at 3.6 mr of $\pi^\pm$, $K^\pm$, p and $\bar{p}$ with momenta between 23 and 197 GeV/c produced by 200 and 300 GeV/c protons incident on beryllium. The results show the yield of each particle for both 200 and 300 GeV/c protons. Various particle ratios are shown as a function of the variable x ($\sim P_{lab}/P_0$). It is seen that the particle ratios show a strong dependence on x, but a little primary momentum dependence. The (thick target) data are compared with the predictions of models for particle production. (auth)

1722 CORRELATIONS BETWEEN LARGE TRANSVERSE MOMENTUM π^0 MESONS AND CHARGED PARTICLES AT THE CERN ISR. Buesser, F. W.; Camilleri, L.; Di Lella, L.; Pope, B. G.; Smith, A. M.; Yoh, J. K. (European Organization for Nuclear Research, Geneva (Switzerland)); Blumenfeld, B. J.; Lederman, L. M. (Columbia Univ., New York (USA)); Cool, R. L.; Litt, L. Phys. Lett., B; 51: No. 3, 306-310(5 Aug 1974).

A study of the charged particles emitted together with a large transverse momentum π^0 was made at the CERN ISR at a center-of-mass energy $\sqrt{s} = 52.7$ GeV. The π^0 mesons and the charged particles were observed in two detectors, each centered at $\theta_{cm} = 90°$ and each covering a laboratory solid angle of 0.59 sr for π^0's and 1.1 sr for charged particles. The multiplicity of charged particles, observed in the same and in the opposite hemisphere as the π^0, was found to be larger than the average multiplicity for inelastic interactions. Some rapidity and azimuthal correlations were observed. (auth)

1723 CORRELATIONS BETWEEN TWO LARGE TRANSVERSE MOMENTUM π^0 MESONS AT THE CERN ISR. Buesser, F. W.; Camilleri, L.; Di Lella, L.; Pope, B. G.; Smith, A. M.; Yoh, J. K. (European Organization for Nuclear Research, Geneva (Switzerland)); Blumenfeld, B. J.; Lederman, L. M. (Columbia Univ., New York (USA)); Cool, R. L.; Litt, L. Phys. Lett., B; 51: No. 3, 311-316(5 Aug 1974).

The correlations between two π^0's of high transverse momentum were studied at the CERN ISR at a center-of-mass energy $\sqrt{s} = 52.7$ GeV. Results are presented for two π^0's detected with an azimuthal separation near 180° and also near 0°. Angular and $P_\perp$ correlations are discussed, as well as invariant mass plots. The observations are compared with some theoretical models of high $P_\perp$ phenomena. The most striking feature of the data is a strong correlation in the transverse momentum of the two π^0's. (auth)

1724 SPIN EFFECTS IN PROTON-PROTON ELASTIC SCATTERING NEAR THE FORWARD DIRECTION. Bourrely, C.; Soffer, J. (Centre National de la Recherche Scientifique, 13 - Marseille (France). Centre de Physique Theorique); Wray, D. (University Coll., London (UK). Dept. of Physics). Nucl. Phys., B; 77: No. 3, 386-396(11 Aug 1974).

Several sets of experimental data on pp elastic scattering in the Coulomb interference region in the range p_{lab} between 9 and 500 GeV/c have been analyzed, in order to estimate the size of the spin dependent part of the strong amplitude. Calling β the ratio of this spin-dependent part to the spin-independent amplitude in the forward direction, it is found that all the data strongly suggest but do not conclusively prove a non-negligible β whose value is around 10% and approximately constant with energy. This result cannot be explained theoretically in terms of exchange of any simple factorizing Regge pole. Important pomeron cut contributions are suggested. Implications of the analysis for some experiments at ISR energies which appear to give rising total cross sections are discussed. (auth)

1725 SOME ASPECTS OF TRANSVERSE MOMENTUM DISTRIBUTIONS OF PARTICLES PRODUCED IN HIGH ENERGY NUCLEON--NUCLEUS INTERACTIONS. Ahmad, I.; Zafar, M.; Irfan, M.; Shafi, M. (Aligarh Muslim Univ., India). Can. J. Phys.; 52: No. 14, 1261-1264(15 Jul 1974).

The p_t distributions of pions, protons, deuterons, tritons, and ^{3}He produced in interactions of 24 GeV/c protons with heavy emulsion nuclei were experimentally investigated. The dependence of $\langle p_t \rangle$ on the shower multiplicity, the angle of emission, and on the mass of the particles was studied. The characteristics of pions were observed to be similar to those produced in hadron-hadron interactions. It was concluded that perhaps the pickup process is responsible for the production of heavier fragments and that most of the pions are produced in the first basic nucleon-nucleon collisions. (auth)

1726 EXTRACTION OF NEUTRON TARGET CROSS SECTIONS FROM REACTIONS ON DEUTERIUM. Julius, D. I. (Univ., Karlsruhe, Ger.). Fortschr. Phys.; 22: No. 6, 311-365(1974).

The theory of scattering and production reactions on deuterium is developed with a view to the extraction of neutron target amplitudes from analysis of deuterium experiments. Corrections to the spectator model due to the following effects are examined: target particle binding corrections to the impulse approximation; the Pauli principle in charge exchange reactions; internal or "Fermi" motion of the target particles; multiple scattering and final state interactions. The closure approximation and the general analysis of single-arm spectrometer experiments are discussed. The connection at high energies and small momentum transfers between the general Watson theory and the Glauber model is established, and the results of calculations of deuterium corrections for pion and rho photoproduction at high energies are reviewed. "Fresnel" and recoil corrections to Glauber theory are examined. An approximation scheme suitable to the analysis of high energy wide angle coincidence or bubble chamber experiments is developed. A special examination is made of the breakdown of the impulse approximation in the 3-3 resonance region, and of the applicability of lowest order binding and multiple scattering corrections in this sensitive kinematical region. (auth)

1727 PION PRODUCTION IN THE REGIME OF TARGET FRAGMENTATION. Schindler, R.; Bromberg, C.; Chaney, D.; Ferbel, T.; Slattery, P. (University of Rochester, Rochester, New York 14627); Cooper, J.; Seidl, A. Phys. Rev. Lett. 33: No. 14, 862-864 (30 Sept 1974).

We examine the energy dependence of π^+ and π^- production in pp collisions for incident laboratory momenta between 6 and 400 GeV/c. The cross section for pion emission into the backward hemisphere in the laboratory frame falls substantially with incident momentum. This departure from the hypothesis of limiting fragmentation for momenta in excess of 20 GeV/c is consistent with an energy dependence of the form expected on the basis of Mueller-Regge ideas. (auth)

1728 OBSERVATION OF DIRECT PRODUCTION OF LEPTONS IN p-Be COLLISIONS AT 300 GeV. Appel, J.A.; Bourquin, M.H.; Gaines, I.; Hom, D.C.; Lederman, L.M.; Paar, H.P.; Repellin, J.; Saxon, D.H.; Snyder, H.D.; Weiss, J.M.; Yoh, J.K. (Columbia University, New York, New York 10027); Brown, B.C.; Gaillard, J.; Yamanouchi, T. Phys. Rev. Lett. 33: No. 12, 722-725 (16 Sept 1974).

Direct production of electrons and muons is observed in 300-GeV p-Be collisions. The yields are much higher than predicted from current models. Data are consistent with charge symmetry and universality. (auth)

1729 NEUTRON-PROTON TOTAL CROSS SECTIONS FROM 30 TO 280 GeV/c. Longo, M.J.; Ayre, C.A.; Gustafson, H.R.; Jones, L.W.; Murthy, P.V.R.; Skubic, P. (Department of Physics, University of Michigan, Ann Arbor, Michigan 48104); Cork, B. Phys. Rev. Lett. 33: No. 12, 725-728 (16 Sept 1974).

We present results of measurements of the n-p total cross section between 30 and 280 GeV/c. The measurements were carried out with a neutron beam by using the standard transmission technique and a liquid-hydrogen target. A total-absorption calorimeter was used to

determine the neutron energy. Our measurements, which have an accuracy of ~1%, indicate a smooth rise of approximately 1.5 mb between 50 and 280 GeV/c. The combined n–p and p–p data above 20 GeV/c are well fitted by the expression $\sigma = 38.4 + 0.85 \pm \ln(s/95)^{1.47}$ mb. (auth)

1730 HADRON PRODUCTION AT LARGE TRANSVERSE MOMENTUM. Appel, J.A.; Bourquin, M.H.; Gaines, I.; Hom, D.C.; Lederman, L.M.; Paar, H.P.; Repellin, J.; Saxon, D.H.; Snyder, H.D.; Weiss, J.M.; Yoh, J.K. (Columbia University, New York, New York 10027); Brown, B.C.; Gaillard, J.; Yamanouchi, T. Phys. Rev. Lett. 33: No. 12, 719-722 (16 Sept 1974).

We have studied production of π^0 with transverse momentum between 2.0 and 4.4 GeV/c at 65 and 93° in the c.m. system in 300–GeV proton–nucleon collisions, by inserting foils of various thickness into a secondary beam and measuring the electron and positron spectra produced by γ conversion. The π^0 invariant cross sections are given at 93 and 65°. We also report invariant cross sections for negatively charged hadrons as a function of transverse momentum. (auth)

1731 AZIMUTHAL CORRELATIONS IN pp INTERACTIONS AT 205 GeV/c. Pratap, M.; Engelmann, R.; Kafka, T. (State University of New York, Stony Brook, New York 11790); Cho, Y.; Fields, T.H.; Hyman, L.G.; Singer, R.; Voyvodic, L.; Walker, R.; Whitmore, J. Phys. Rev. Lett. 33: No. 13, 797-801 (23 Sept 1974).

Using data obtained from an exposure of the 30–in. Fermi National Accelerator Laboratory bubble chamber to a 205–GeV/c proton beam, results are presented on azimuthal distributions. Evidence is presented for dynamical azimuthal correlations whose behavior depends on the particular charge combination. The dependence of the azimuthal correlations on the rapidity difference and on the transverse momentum is also given. (auth)

1732 TOTAL CROSS SECTIONS OF p AND $\bar{p}$ ON PROTONS AND DEUTERONS BETWEEN 50 AND 200 GeV/c. Carroll, A.S.; Chiang, I.; Kycia, T.F.; Li, K.K.; Mazur, P.O.; Mockett, P.; Rahm, D.C.; Rubinstein, R. (Brookhaven National Laboratory, Upton, New York 11973); Baker, W.F.; Eartly, D.P.; Giacomelli, G.; Koehler, P.F.M.; Pretzl, K.P.; Wehmann, A.A.; Cool, R.L.; Fackler, O. Phys. Rev. Lett. 33: No. 15, 928-931 (7 Oct 1974).

Proton and antiproton total cross sections on protons and deuterons have been measured at 50, 100, 150, and 200 GeV/c. The proton cross sections rise with increasing momentum. Antiproton cross sections fall with increasing momentum, but the rate of fall decreases between 50 and 150 GeV/c, and from 150 to 200 GeV/c there is little change in cross section. (auth)

1733 THE nn SCATTERING AMPLITUDE AT 845 MeV/c. Dutton, L. M. C.; Howells, R. J. W.; Jafar, J. D.; van der Raay, H. B.; Stiegelmair, J. A. (Birmingham Univ. (UK). Dept. of Physics). Nucl. Phys., B; 78: No. 3, 484-492(4 Sep 1974).

Experimental data on dd small-angle elastic scattering in the Coulomb interference region are analyzed to yield the dd scattering amplitude. This amplitude is then expressed in terms of the nucleon–nucleon scattering amplitudes and the Glauber correction. The value for the nn scattering amplitude found is shown to be in good agreement with the pp amplitude. (auth)

1734 A STUDY OF FINAL STATE DEUTERON EVENTS IN 1.825 GeV/c pd INTERACTIONS. Babalola, I. A.; Forson, A. G. (Ibadan Univ. (Nigeria)); Osadebe, F. A. N. (Department of Physics, University of Ife, Ife–Ife, Nigeria). Nucl. Phys., B; 78: No. 3, 561-575(4 Sep 1974).

The study of pd → ndπ^+ and pd → pdπ^0 reactions shows that the "slow deuteron" inelastic events are dominated by peripheral processes. Box diagrams are presented for the production mechanism of the 2.2 GeV/c^2 dπ enhancements. Evidence is presented that for "fast deuteron" events d^{*++} and d^{*+} resonances at 2.375 ± 0.010 GeV/c^2 with a width of 0.075 ± 0.015 GeV/c^2 are produced via baryon exchange. The elastic events have been compared with Glauber multiple scattering theory with reasonable agreement. (auth)

1735 CORRELATIONS IN QUASI-ELASTIC PROTON-PROTON SCATTERING AT TOTAL c.m. ENERGIES OF 23 AND 31 GeV. Albrow, M. G.; Barber, D. P.; Bogaerts, A.; Bosnjakovic, B.; Brooks, J. R.; Chang, C. Y.; Clegg, A. B.; Erne, F. C.; Kooijman, P.; Loebinger, F. K. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Lett., B; 51: No. 4, 424-428(19 Aug 1974).

Data are reported on angular and rapidity (η) distributions of a charged particle c produced in quasi-elastic proton–proton scattering (p + p → p + c + anything) at the CERN ISR. (auth)

1736 INCLUSIVE TWO CHARGED PARTICLE CORRELATIONS IN pp COLLISIONS AT TOTAL c.m. ENERGIES OF 45 AND 53 GeV. Albrow, M. G.; Barber, D. P.; Bogaerts, A.; Bosnjakovic, B.; Brooks, J. R.; Chang, C. Y.; Clegg, A. B.; Erne, F. C.; Kooijman, P.; Loebinger, F. K. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Lett., B; 51: No. 4, 421-423(19 Aug 1974).

Measurements are reported of two particle correlations between either a π^+, p or $\bar{p}$ identified in the CHLM small angle spectrometer, and a second charged particle in the central (pionization) region. The results show short range correlation effects for each type of identified particle. Interpreting the data in terms of a cluster model, the measurements suggest that ~50% of clusters produced at rapidity ~2.4 emit a proton. (auth)

1737 SEARCH FOR MASSIVE LONG-LIVED PARTICLES IN ALUMINUM TARGETS IRRADIATED BY 300 GeV AND 400 GeV PROTONS. Yang, W. Brooklyn; Polytechnic Inst. of Brooklyn (1974). 84p. University Microfilms Order No. 74-22,509.

Thesis (Ph. D.).

A search was conducted at the National Accelerator Laboratory for massive long-lived particles. A directional gas Cherenkov counter with gamma threshold greater than 25 installed in an existing beam pipe above the target permitted the measurements to be made parasitically while the accelerator was running for prime users. Two measurements were made at bombarding energies of 300 and 400 GeV. The aluminum targets were $^3/_8$ inch × $1^1/_4$ inch × 12 inches long and $^1/_4$ inch in diameter × 13 inches long respectively. No long-lived particles were observed with cross section for production and capture greater than approximately 10^{-36} cm^2 in a mean life range of a few milliseconds to a few hours. (Diss. Abstr. Int., B)

1738 MEASUREMENT OF THE PROCESS p + d → ^{3}He + PHOTON AT INTERMEDIATE ENERGIES. Kline, R. V. Pasadena, CA; California Inst. of Tech. (1974). 201p. University Microfilms Order No. 74-21,596.

Thesis (Ph. D.).

The process pd → ^{3}Heγ in the energy region of $\Delta(1236)$ nucleon isobar excitation was measured. At an incident proton energy of 462 MeV, data were assembled for center of mass angles of 45, 60, 75, 90, 105, 120, and 135°. Also the energy dependence of the 90° cross section in the center of mass, for incident proton energies of 377, 462 and 576 MeV was measured. Implications for T-invariance in the electromagnetic interaction are discussed by a detailed balance comparison with the inverse reaction. In addition, an angular distribution is presented for the process pd → ^{3}Heπ^0 at an incident proton energy of 462, as well as limited angular distributions at 377 and 576 MeV. (Diss. Abstr. Int., B)

Strong (Meson-induced)

Refer also to abstract 1902.

1739 (CRN/HE-73-16) ANALYSIS OF THE LONGITUDINAL PHASE SPACE OF THE $K^+\pi^+\pi^-$ SYSTEM PRODUCED BY 10-GeV/c K^+ ON NUCLEI. Blind, R. (Centre National de la Recherche Scientifique, 67–Strasbourg (France) Centre de Recherches Nucleaires). 1973. 114p. (In French). Dep. NTIS (US Sales Only) $8.75.

Thesis. Submitted to Univ., Strasbourg.

The analysis of the studied reaction shows an accumulation of events in the Q mass region. The angular distribution forward–backward asymmetry, the assignment of spin–parity for $Q^+ \rightarrow K^+\pi$ is a value of 1^+. It is noted that the K$\pi\pi$ mass spectra is especially interesting. (JFP)

1740 (KHFTI-73-10, pp 59-61) SEARCH OF COHERENT PRODUCTION IN $\pi^- C^{12} \rightarrow 5\pi^- C^{12}$ REACTION AT 5 GeV/c IN PROPANE CHAMBER. Amaglobeli, N. S. (Tbilisi State Univ., USSR); Salukvadze, R. G.; Khubua, D. I. 1973. (In Russian).

A search for the coherent production in the reaction $\pi^- C^{12} \geq (\pi^-\pi^-\pi^-\pi^+\pi^+) C^{12}$ was carried out with the propane chamber. The distribution of the number of events in the four-momentum squared function, transmitted by the pions flying from the five-pion system was studied. The upper limit for the cross section of coherent production of pions is 36 μb/nucleus (95% confidence level). Wide peaks, characteristic of processes of coherent production, were not observed in the effective mass spectra obtained. (INIS)

1741 (LBL-53) π^+p, π^+n, AND π^+d INTERACTIONS: A COMPILATION. Part I. Chew, D. M.; Henri, V. P.; Lasinski, T. A.; Trippe, T. G.; Uchiyama, F.; Winkelmann, F. C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1973. 210p. Dep. NTIS $13.50.

The data compilation on π^+p, π^+n, and π^+d interactions covers the various final states, differential cross sections, polarization data, indices, and a list of other compilations. (JFP)

1742 (LBL-55) COMPILATION OF K^0_L N INTERACTIONS. Uchiyama, F.; Loos, J. S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; Stanford Linear Accelerator Center, Calif. (USA)). Mar 1972. 44p. Dep. NTIS $5.25.

All 13 papers reporting K^0_L N interactions are compiled. Cross sections, differential cross sections, angular distributions, forward differential cross sections, and the phase for regeneration are summarized. A brief synopsis is given for seven experiments in progress at the time of this compilation. The cutoff date for this report was 1 January 1972. (auth)

1743 MULTIPLE PRODUCTION OF MESONS WITH 22.6 GeV/c PROTONS. Shibata, M.; Maeda, Y.; Manabe, K.; Miyamura, K. (Yokohama National Univ., Japan). Uchusen Kenkyu; 18: No. 2, 143-153(Dec 1973). (In Japanese).

A study on the mechanism of the multiple production of mesons by the analysis of the emission angle of secondary particles was developed. The results of analysis of the nuclear plates exposed to proton beam of 22.6 GeV/c at CERN are reported. The plates were set parallel to the beam of intensity of $6 \times 10^4/cm^2$. The emission angle and grain density were measured on 91 events of $N_h < 2$ (number of heavy tracks). The criteria used for the analysis were as follows: (1) ρ (grain density) < 33/100 μ m, (2) $n_s \geq 3$, and (3) $K_M < 1$, where K_M is inelasticity in a mirror system. Values of K_M were obtained from the average values of transverse momentum of secondary particles and emission angle in a laboratory system. Distribution of relative width for log $\tan\frac{\theta}{2}$ was obtained. Simulation was performed by the Monte Carlo method, and the results were compared with the experimental ones. It is concluded that the phenomena of multiplicity n_s of $3 \sim 7$ were not able to be interpreted as the isotropic emission of secondary particles from a single center. A system with two centers was considered, and a Lorentz factor r^* was introduced for these two centers. The energy dependence of the correlation of r^* and n_s may be a good indicator for the study on the mechanism of multiple production of mesons. (tr-auth)

1744 EXPERIMENTAL DETERMINATION OF THE REAL PART OF THE K-p FORWARD ELASTIC SCATTERING AMPLITUDE AT 14.3 GeV/c AND AN ANALYSIS OF DISPERSION RELATION CALCULATIONS. Meijer, R. W. Amsterdam; Univ. Amsterdam (1973). 78p.

Thesis.

Part A of the thesis describes an experiment to determine the real part of the K^-p nuclear elastic scattering amplitude in the forward direction by means of the Coulomb interference method. The experimental material consisted of 75000 pictures of the CERN 2 meter hydrogen bubble chamber exposed to an electrostatically separated beam of K^- mesons of 14.3 GeV/c incident momentum. Small angle elastic scatterings down to 3 mrad projected scattering angle were reliably detected. The result of the experiment is the ratio α of real to imaginary part of the K^-p nuclear elastic scattering amplitude in forward direction: $\alpha = -0.10 \pm 0.09$. The exponential slope of the differential elastic cross section is (8.7 ± 0.2) $(GeV/c)^{-2}$. The theoretical considerations reported in part B make use of dispersion relations to predict the value of the real part for K^+p in the forward direction from integrals of the total cross sections of K^+p scattering over the energy. First the mathematical formulation and the techniques used for numerical evaluation are described, and then the results of the calculations are given for different assumptions on the asymptotic behaviour of the total cross sections. A careful analysis of the predictions shows that at energies below 100 GeV the asymptotic behaviour of the total cross sections reflects only very slightly in the values for the real parts. A comparison with measured real parts at those energies, therefore, will not enable us to decide between e.g. a constant asymptotic limit or a logarithmic rise with energy of total cross sections. Nor will it be possible to draw a conclusion with regard to a possible violation of the Pomeranchuk theorem. It follows from the predictions that, in the case of a valid Pomeranchuk theorem, the rate of approach of K^-p and K^+p total cross sections with energy is a parameter with does reflect significantly in the α-values. The experimental data for α which are available at the present do not allow, however, to fix this rate of approach very well. (NL)

1745 BACKWARD PRODUCTION OF K*(892) IN THE REACTIONS $K^+N \rightarrow K\pi N$ IN HYDROGEN AND DEUTERIUM FOR THE INCIDENT MOMENTUM RANGE 3-5 GeV/c. Charriere, G.; Dunwoodie, W.; Ferro-Fontan, G.; Goldschmidt-Clermont, Y.; Grant, A.; Muller, F.; Nikolic, M.; Quinquard, J. (European Organization for Nuclear Research, Geneva (Switzerland)); Dehm, G.; Geist, W. Nucl. Phys., B; 76: No. 2, 189-208(11 Jul 1974).

Data on backward production of K* (892) are presented for the reactions $K^+d \rightarrow K^+\pi^- pp_s(1)$, $K^+p \rightarrow K^0\pi^+p(2)$ and $K^+d \rightarrow K^0\pi^+np_s(3)$ in the incident momentum range 3-5 GeV/c. For reaction (1) at 4.6 GeV/c backward production of K* (1420) is also observed. The cross sections for backward K* (892) production in reactions (1) and (2) are found to be the same within error, and to exhibit a (p^{-1}_{lab}) energy dependence with $n = 3.2 \pm 0.5$. Production and decay distributions are investigated, and SU(3) comparisons made with other reactions involving backward meson production. (auth)

1746 THE INCLUSIVE REACTION $K^-p \rightarrow pX$ AT 14.3 GeV/c. Tovey, S. N.; Paler, K.; Shah, T. P.; Miller, R. J.; Phelan, J. J. (Science Research Council, Chilton (UK). Rutherford Lab.); Chaurand, B.; Drevillon, B.; Gago, J. M.; Labrosse, G.; Lestienne, R. Nucl. Phys., B; 76: No. 2, 290-300(11 Jul 1974).

The reaction $K^-p \rightarrow pX$ at 14.3 GeV/c has been measured in the fragmentation region of the target proton. The differential cross section is studied as a function of momentum transfer and missing mass squared. In the triple-Regge limit, it is consistent with the dominance of a MMP coupling at large t but it is possible that couplings of the type PPP and $\pi\pi P$ also contribute at small $|t|$ values. (auth)

1747 THE REACTION $K^+d \rightarrow K^0\pi^+d$ AT 4.6 GeV/c AND THE EFFECTIVE EXCHANGED TRAJECTORY FOR THE REACTIONS $K^+d \rightarrow K^*(892)d$. Charriere, G.; Dunwoodie, W.; Grant, A.; Goldschmidt-Clermont, Y.; Muller, F. Quinquard, J. (European Organization for Nuclear Research, Geneva (Switzerland)); de Jongh, G.; Tavernier, S. (Institute for High Energies, ULB-VUB, Brussels, Belgium); Cornet, P.; Dufour, P. Nucl. Phys., B; 76: No. 2, 333-346(11 Jul 1974).

In an experiment with the CERN 2 metre DBC the reaction $K^+d \rightarrow K^0\pi^+d$ is studied at an incident momentum of 4.6 GeV/c. The cross section is found to be (66 ± 10) μb for four-momentum transfer squared from target to recoil deuteron greater than 0.02 GeV^2, and the reaction is dominated by the production of K^{*+} (892) via natural parity exchange. Using data for the reactions $K^+d \rightarrow K^{*+}$ (892)d in the incident momentum range 2-13 GeV/c the parameters of the effective exchanged trajectory are estimated. (auth)

1748 MULTIPLICITY CROSS SECTIONS FOR 100 GeV/c π^-p INTERACTIONS. Berger, E. L.; Cocconi, V. T.; Counihan, M. J.; Coghen, T.; Gensch, U.; Karimaeki, V.; Kellner, G.; Kotanski, A.; Kuhn, D.; Morrison, D. R. O. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 77: No. 3, 365-374(11 Aug 1974).

Charged particle multiplicity cross sections for 100 GeV/c π^-p inelastic interactions are presented and compared with results at other energies. The results for multiplicities $n \geq 4$ show a consistent trend in their energy dependence. The two-prong cross section curve differs as it tends to flatten off at the higher energies. The zero-prong cross section values decrease steeply as p^{-1}_{lab}. The results for $n \geq 2$ for π^-p and pp reactions appear to lie on a "universal" curve if $n\sigma_n/\sigma_{inel}$ is plotted against $\langle n \rangle/n$. This "scaling" rule is equivalent to KNO scaling, but the plot suggested here is more useful in studying low multiplicities. An interpretation in terms of a two-component model and a possible extrapolation to higher energies are proposed. (auth)

1749 T-DEPENDENCE AND PRODUCTION MECHANISMS OF THE ρ, F AND G RESONANCES FROM $\pi^-p \rightarrow \pi^-\pi^+n$ AT 17.2 GeV. Hyams, B.; Jones, C.; Weilhammer, P. (European Organization for Nuclear Research, Geneva (Switzerland)); Blum, W.; Dietl, H.; Grayer, G.; Lorenz, E.; Luetjens, G.; Maenner, W.; Meissburger, J. Phys. Lett., B; 51: No. 3, 272-278(5 Aug 1974).

The t-dependence of ρ, f and g resonance production is compared using data from the CERN-Munich spectrometer. An amplitude analysis is performed, and the significance for various proposed models of the production mechanism discussed. The OPE term becomes increasingly adequate to describe the data as the resonant mass increases. (auth)

1750 $K^-p \rightarrow \bar{K}^0n$ AT 3,4,5 AND 6 GeV/c. Ambats, I.; Lesnik, A.; Meyer, W. T.; Rust, D. R.; Ward, C. E. W.; Yovanovitch, D. D. (Argonne National Lab., Ill. (USA)). Nucl. Phys., B; 77: No. 2, 269-280(4 Aug 1974).

New measurements of the differential cross sections are presented for $K^-p \rightarrow \bar{K}^0n$ at 3, 4, 5 and 6 GeV/c where 248,538,761, and 376 events, respectively, are studied. Total cross sections

are obtained by integrating the differential cross sections. This data is combined with other data from 3 to 15.7 GeV/c to calculate an effective Regge trajectory for this reaction. Comparisons are made to predictions from exchange degeneracy and SU(3) sum rules. (auth)

1751 BACKWARD PRODUCTION OF MESON RESONANCES IN 4 GeV/c π^+d INTERACTIONS. Emms, M. J.; Kinson, J. B.; Stacey, B. J.; Votruba, M. F.; Woodworth, P. L. (Birmingham Univ. (UK)); Bell, I. G.; Dale, M.; Evans, D.; Major, J. V.; Neat, K. (Durham Univ. (UK)). Phys. Lett., B; 51: No. 2, 195-199 (22 Jul 1974).

The backward production of ρ^0, f^0 and ω^0 mesons at 4 GeV/c has been studied. Results are presented on total and differential cross sections, and on the spin density matrix elements. The results suggest (i) that the three reactions studied are mediated by similar exchanges; (ii) that they resemble backward photoproduction data rather than backward elastic scattering data; and (iii) that substantial s-wave contributions could be present in the ρ^0 and f^0 regions. (auth)

1752 INCLUSIVE γ PRODUCTION IN K^-p INTERACTIONS AT 14.3 GeV/c. Pierre, F.; Bardadin-Otwinowska, M.; Barloutaud, R.; Borg, A.; Pons, Y.; Spiro, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires); Chaurand, B.; Drevillon, B.; Gago, J. M.; Labrosse, G. Nucl. Phys., B; 77: No. 1, 45-55 (25 Jul 1974).

Results are presented on γ production in K^-p interactions at 14.3 GeV/c. The analysis is based on 2541 fitted e^+e^- pairs in a hydrogen bubble chamber. The inclusive cross section for γ production is found to be (54.5 ± 1.8) mb. The average number of γ's per inelastic event is 2.93 ± 0.12; it exhibits no strong dependence on charged multiplicity. From the $P_{L\,0}$ and P_T^2 invariant distributions of the γ, a simple function describing the π^0 invariant distribution is determined. (auth)

1753 MULTIPLICITY DISTRIBUTIONS OF SECONDARY CHARGED PARTICLES IN π^-p, π^-n, and π^-c INTERACTIONS AT THE MOMENTUM p = 40 GeV/c. Abesalashvili, L. N.; Amaglobeli, N. S.; Gersamiya, D. V.; Goguadze, L. G.; Dasaeva, M. A.; Dzhmukhadze, S. V.; Salukvadze, R. G.; Topuridze, M. V.; Chargeishvili, M. S.; Shakulashvili, O. A.; Shudra, O. S. (Tbilissi State Univ., USSR). Soobshch. Akad. Nauk Gruz. SSR; 75: No. 3, 577-580 (Sep 1974). (In Russian).

Multiplicity distributions of secondary charged particles in π^-p, π^-n, and π^-C interactions at the momentum p = 40 GeV/c are presented. The topological section is also given for π^-p reaction as well as dependences between the number of slow protons and relativistic particles for π^--^{12}C interaction. (auth)

1754 RESONANCE POLE WITH $J^P = 3/2^+$ IN A COUPLED-CHANNEL ANALYSIS OF K^+p ELASTIC SCATTERING DATA. Arndt, R.A.; Hackman, R.H.; Roper, L.D. (Virginia Polytechnic Institute and State Univeristy, Blacksburg, Virginia 24061); Steinberg, P.H. Phys. Rev. Lett. 33: No. 16, 987-990 (14 Oct 1974).

Energy-dependent partial-wave amplitudes based on a coupled-channel (K^+p,$K\Delta$) K-matrix formalism are obtained for elastic K^+p scattering up to P_{lab}=2 GeV/c. The data used include new high-precision differential cross sections. A total of 42 parameters describing the $l \leq 4$ partial waves are used to fit 3822 data points and the best solution found has a χ^2 per degree of freedom of 1.33. This solution exhibits a T-matrix Z^* resonance pole in the P_3 partial wave with mass coordinates 1787-i100 MeV. (auth)

1755 TOTAL CROSS SECTIONS OF π^* AND K^* ON PROTONS AND DEUTERONS BETWEEN 50 AND 200 GeV/c. Carroll, A.S.; Chiang, I.; Kycia, T.F.; Li, K.K.; Mazur, P.O.; Mockett, P.; Rahm, D.C.; Rubinstein, R. (Brookhaven National Laboratory, Upton, New York 11973); Baker, W.F.; Eartly, D.P.; Giacomelli, G.; Koehler, P.F.M.; Pretzl, K.P.; Wehmann, A.A.; Cool, R.L.; Fackler, O. Phys. Rev. Lett. 33: No. 15, 932-935 (7 Oct 1974).

Total cross sections of π^* and K^* on protons and deuterons have been measured at 50, 100, 150, and 200 GeV/c. All of the cross sections rise with increasing momentum. (auth)

1756 A_2-A_1 INTERFERENCE PHASE. Ascoli, G.; Jones, L.M.; Klanner, R.; Kruse, U.E.; Wyld, H.W. (University of Illinois at Urbana, Urbana, Illinois 61801). Phys. Rev. Lett. 33: No. 10, 610-613 (2 Sept 1974).

The A_2-A_1 phase difference observed in $\pi^-p \to \pi^+\pi^-\pi^-p$ is compared with the A_2^- phase from a Regge fit to the $d\sigma/dt$ data for A_2^- and the A_1^- phase given by a Reggeized Deck model. The agreement (~30°) depends crucially on the contribution of the Reggeized pion propagator to the A_1 phase and requires equal signs for the f and P residues in the A_2 amplitude. (auth)

1757 OBSERVATION OF A DIP DUE TO I=O t-CHANNEL EXCHANGE IN THE REACTION $\pi N \to A_2 N$ AT 4.5 AND 6 GeV/c. Gordon, H.A.; Habibi, M.; Stumer, I. (Brookhaven National Laboratory, Upton, New York 11973); Lai, K. Phys. Rev. Lett. 33: No. 10, 603-606 (2 Sept 1974).

In the reaction $\pi^-p \to A_2^-p$, we observe a dip in the differential cross section at $t \simeq 1.2$ GeV^2. Analysis in terms of t-channel contributions from isospin-O and -1, natural- and unnatural-parity exchanges suggest that the dip is mainly due to natural-parity, I=O exchange. (auth)

1758 MEASUREMENT OF PION-NUCLEAR ELASTIC AMPLITUDES AT ZERO DEGREES AROUND THE $3/2$, $3/2$ RESONANCE. Gabitzsch, N. D. Houston, TX; Rice Univ. (1974). 180p. University Microfilms Order No. 74-21,272.

Thesis (Ph. D.).

The real and imaginary parts of the pion-forward elastic nuclear scattering amplitude were measured for the targets ^{9}Be, ^{12}C, ^{16}O, and ^{27}Al in the energy interval 114 to 210 MeV. The imaginary part of the nuclear elastic amplitude is determined from total nuclear cross section measurements using the optical theorem. The real part of the forward nuclear elastic amplitude is extracted from the Coulomb-nuclear interference in the differential cross sections at small angles. It is observed that the π-nuclear total cross sections reach their maximum value near the pion-nucleon resonance (T^{CM} = 152 MeV) when examined as a function of the π-nuclear center-of-mass coordinate system ($T^{CM} = E_{TOT} - (m + M)\,C^2$), while the real part of the forward elastic nuclear amplitudes for ^{12}C, ^{16}O, and ^{27}Al pass through zero at an energy greater than that of the π-nucleon forward elastic amplitude, the peak of the π-nuclear total cross sections investigated scale as $A^{\frac{1}{3}}$, while away from the peak the cross sections deviate from this scaling, the measured total cross sections exhibit considerable broadening with respect to the pion-nucleon ($3/2$, $3/2$) resonance, and the π^+ and π^- total cross section for the n = z nuclei, studied (^{12}C and ^{16}O) are shifted in magnitude such that $\sigma^-_{TOT}(T_\pi^L) > \sigma^+_{TOT}(T_\pi^L)$, and shifted in energy with the π^- total cross sections peaking at a lower energy than the π^+ total cross sections. This indicates a Coulomb distortion of the nuclear amplitude. (Diss. Abstr. Int., B)

1759 DECAY SCHEME OF THE ρ'(1600) MESON. Bernabei, R. (Univ., Rome); D'Angelo, S.; Spillantini, P.; Valente, V. Lett. Nuovo Cim.; 11: No. 4, 261-264 (28 Sep 1974).

The results are given of an analysis of the $e^+e^- \to 2\pi^+2\pi^-$ cross sections at 2E = 2.0 GeV. A signal in the ρ^0 region and a structure around a mass of 1 GeV are observed. The decay scheme of the $\rho'(1600) \to \rho^0 + (\pi^+\pi^-)_{S\text{-waves}} \to 2\pi^+2\pi^-$ is given, where $(\pi^+\pi^-)_{S\text{-waves}}$ denotes an S-wave $\pi\pi$ system. (JFP)

1760 DOUBLE REGGE POLE EXCHANGE MODEL ANALYSIS OF A 7 GeV/c π^-p EXPERIMENT. Chao, A. C. L. Toronto; Univ. of Toronto (1973). National Library of Canada, Ottawa.

Thesis (Ph. D.).

A double regge pole exchange model is used to analyze quasi-three-body final states selected from a 7 GeV/c π^-p experiment. Three sets of data are analyzed namely: (I) $\pi^-p \to p\pi^+\pi^-\pi^-$, (II) $\pi^-p \to p\pi^+\pi^-\pi^-\pi^0$, and (III) $\pi^-p \to \pi^+\pi^+\pi^-\pi^-n$. The final states, selected from data sets I, II and III are ($\rho^0\pi^-$p, $f^0\pi^-$p, $\pi^-\pi^-\Delta^{++}$), ($\rho^0\pi^-\Delta^+$, $\rho^-\pi^-\Delta^{++}$, $\omega\pi^-$p) and ($\rho^0\pi^-\Delta^+$), respectively. It is found that these channels after appropriate kinematic cuts can be well described by exchanging two Regge trajectories. Predictions for the absolute cross sections were also obtained by taking limits of one particle exchange and a diffraction scattering approximation. (Diss. Abstr. Int., B)

1761 S- AND t-CHANNEL HELICITY CONSERVATION OF PION INDUCED NUCLEON DIFFRACTION DISSOCIATION AT 3.9 GeV/c AND THE IMPLICATIONS OF A TWO-COMPONENT MODEL. Berlad, G.; Haber, B.; Hodous, M. F.; Hulsizer, R. I.; Kistiakowsky, V.; Levy, A.; Pless, I. A.; Singer, R. A.; Wolfson, J.; Yamamoto, R. K. (Massachusetts Inst. of Tech., Cambridge (USA)). Nucl. Phys., B; 78: No. 1, 29-54 (18 Aug 1974).

A study of s-channel and t-channel helicity conservation has been carried out on a prism plot separated sample of 3.9 GeV/c $\pi^+p \to \pi(N\pi)_{dd}$ diffraction dissociation events. s-Channel helicity conservation is found to be strongly violated while t-channel helicity conservation is found to be mildly violated. These results are similar to that found at 11.7 GeV/c. These violations are explained on the basis of a "two-component model" of which the first component is a single exchange amplitude. It is postulated that this amplitude is the generalization of the pomeron exchange amplitude which may conserve s-channel helicity. The second

component of the model is a double exchange mechanism which strongly violates s-channel helicity. The predictions of this model agree with the experimental data. (auth)

1762 ANALYSIS OF THE Kω SPECTRUM. Chung, S. U.; Eisner, R. L.; Protopopescu, S. D.; Samios, N. P.; Strand, R. C. (Brookhaven National Lab., Upton N. Y. (USA)). Phys. Lett., B; 51: No. 4, 413-416(19 Aug 1974).

Results of a spin-parity analysis of the Kω system from threshold to 1.52 MeV based on 12500 events of the type $K^-p \to K^-\pi^+\pi^-\pi^0 p$ at 7.3 GeV/c are presented. Evidence for a possible resonant state decaying into Kω at a mass 1710 ± 15 MeV and width 110 ± 50 MeV is also presented. (auth)

1763 PRODUCTION AND DECAY PROPERTIES OF THE B MESON. Chaloupka, V.; Ferrando, A.; Losty, M. J.; Montanet, L. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Lett., B; 51: No. 4, 407-412(19 Aug 1974).

Results of a mass independent spin-parity analysis of the ωπ system from the reaction $\pi^-p \to p\omega\pi^-$ at 3, 9, 5, and 7.5 GeV/c are presented. A unique $J^P = 1^+$ assignment is obtained for the B meson as well as results on its production density matrix and the D/S ratio of its decay. (auth)

1764 PION AND NUCLEON DISSOCIATION IN $\pi^-p \to \pi^-\pi^+\pi^-p$ AT 205 GeV/c. Bingham, H. W.; Chew, D. M.; Fretter, W. B.; Graves, W. R.; Stutte, L.; Yost, G. P. (California Univ., Berkeley (USA). Dept. of Physics); Abrams, G. S.; Daugeras, B. Y.; Friedberg, C. E.; Goldharber, G. Phys. Lett., B; 51: No. 4, 397-401 (19 Aug 1974).

In a 48,000-picture exposure of the Fermilab 30-inch hydrogen bubble chamber to a 205 GeV/c π^- beam, 169 events of the reaction, $\pi^-p \to \pi^-\pi^+\pi^-p$, with a cross section of 635 ± 61 μb, have been measured. This reaction proceeds almost entirely via low mass $\pi^- \to 3\pi$ and $p \to p\pi\pi$ dissociation. Factorization is satisfied for $p \to p\pi\pi$ dissociation in πp and pp interactions. (auth)

1765 MEASUREMENT OF HIGH MOMENTUM TRANSFER $\pi^-p \to \pi^0 n$ AT 5.9 GeV/c. Brockett, W. S.; Corlew, G. T.; Frisken, W. R.; Jenkins, T. L.; Kirby, A. R.; Smith, W. M.; Strelzoff, A. G.; Sullivan, C. R. (Case Western Reserve Univ., Cleveland, Ohio (USA)). Phys. Lett., B; 51: No. 4, 390-392(19 Aug 1974).

The differential cross section for $\pi^-p \to \pi^0 n$ has been measured in the t range $1.8 \leq |t| \leq 8.2$ $(GeV/c)^2$ by a counter-spark chamber experiment detecting the neutron and both π^0 decay photons. A broad minimum was found, centered at $|t| = 5.2$ $(GeV/c)^2$. (auth)

1766 INCLUSIVE TWO-PARTICLE CORRELATIONS IN 40 GeV/c π^-p COLLISIONS AND PARTICLE PRODUCTION MECHANISMS. Blutner, R.; Ilgenfritz, E. M.; Kripfganz, J.; Kuehnicke, H.; Lemke, E. H.; Moehring, H. J.; Ranft, G.; Ranft, J. (Leipzig Univ. (German Democratic Republic). Physikalisches Inst.); Fadeev, N. G.; Grishin, V. G. Nucl. Phys., B; 78: No. 2, 333-344(25 Aug 1974).

Inclusive two-particle correlations in rapidity variables between $\pi^+\pi^-$, $\pi^+\pi^+$, and $\pi^-\pi^-$ obtained in 40 GeV π^-p collisions are discussed in the framework of the Mueller Regge model and the multiperipheral cluster model. The data show features similar to the data reported at much higher energies from the CERN ISR. This behavior is more easily understood from the multiperipheral cluster model. Data on transverse momentum correlations in the same reactions can be qualitatively understood from the same model. (auth)

1767 K^+p ELASTIC SCATTERING FROM 130 TO 755 MeV/c. Cameron, W.; Hirata, A. A.; Jennings, R.; Morton, W. T. (Glasgow Univ. (UK). Dept. of Natural Philosophy); Cazzoli, E.; Giacomelli, G.; Lugaresi-Serra, P.; Mandrioli, G.; Minguzzi-Ranzi, A. (Istituto Nazionale di Fisica Nucleare, Bologna (Italy)); Castelli, E. Nucl. Phys., B; 78: No. 1, 93-109(18 Aug 1974).

Differential cross sections for the elastic scattering of K^+ mesons on protons have been measured at 12 lab momenta between 130 and 755 MeV/c using a hydrogen filled bubble chamber. The results are consistent with a repulsive S-wave nuclear force. A phase-shift analysis yielded the following values of the low-energy parameters: $a_{S_{\frac{1}{2}}} = (0.309 \pm 0.002)$ fm, $r_{S_{\frac{1}{2}}} = (0.32 \pm 0.02)$ fm, $a_{P_{\frac{1}{2}}} = -(0.021 \pm 0.002)$ fm, $a_{P_{\frac{3}{2}}} = (0.013 \pm 0.001)$ fm^3. (auth)

1768 EXPERIMENTAL RESULTS ON π^-p INTERACTIONS IN THE CM ENERGY RANGE 1.50-1.74 GeV. Dolbeau, J.; Neveu, M.; Triantis, F. A.; Coutures, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. of Physique des Particles Elementaires). Nucl. Phys., B; 78: No. 2, 233-250(25 Aug 1974).

Channel cross sections, elastic differential cross sections and single pion production mass spectra and angular distributions are presented for π^-p interactions, based on 139,000 events observed at six energies in the center of mass region 1.50-1.74 GeV. (auth)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstracts 1689 and 1942.

1769 (FRNC-TH-500) REGGE CUTS AND DUALITY IN THE PHENOMENOLOGY OF HIGH ENERGY REACTIONS. Peschanski, R. (Paris-6 Univ., 75 (France)). 1973. 162p. (In French). Dep. NTIS (US Sales Only) $11.25.

Thesis.

Emphasis is given to the part played by Regge pole cuts in the problem of correcting absorption and peripherism effects on scattering amplitudes. The phenomenological necessity of considering a new cut contribution having specific properties in addition to absorption cuts in the different reactions is discussed. This contribution must be essentially real, possess a negative signature, be central (low partial waves), and have a lower intercept than the usual Regge poles. A phenomenological model suitable for describing high energy two-body reactions is presented. This model is used to analyze π-nucleon, K-nucleon, and $\bar{K}$-nucleon scattering. The following modifications are made in order to overcome the difficulties encountered with the absorbed Regge pole model: the introduction of lower intercept singularities in the framework of an R, P, R*P, R*R, R*R*P, R*P*R type perturbation expansion; the expressing of this expansion in a form consistent with Regge cut calculation rules using duality diagrams. The most interesting results concern the Regge cut selection rules; these results show that R*P*R cuts are the essential factors necessary to correctly explain the experimentally observed behavior. In this way, a satisfactory description is obtained of reactions involving a small number of parameters. It is also demonstrated that the physical nature of R*P*R cuts together with the sign and strength of their contributions can be associated with a modification in the multiperipheral model for multiple-production reactions using the unitarity relation. (auth)

1770 (RRK-73-5) POLYA-EGGENBERGER DISTRIBUTION IN MULTIPARTICLE PRODUCTION AT VERY HIGH ENERGIES. Minakata, H. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Apr 1973. 19p. NTIS (US Sales Only).

It is shown that the Pólya-Eggenberger distribution successfully describes the experimental data on multiplicity distribution in very high energy production processes. The distribution is compatible with the semi-inclusive scaling proposed by Koba, Nielsen and Olesen, and reproduces the scaling limit curve fairly well. Critical comments on other models and a brief mention on the nature of correlations are also presented. (auth)

1771 HIGH ENERGY PHYSICS INDEX. Volume 12, No. 19, 1974. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). 19p.

1772 STUDY OF STRANGE PARTICLE FORMATION CROSS-SECTIONS WITHIN THE FRAMEWORK OF A STATISTICAL ISOSPIN MODEL. Lipin, V. D.; Yuldashev, B. S. (Physical-Technical Inst., Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 4, 22-25(1974). (In Russian).

The isotopic spin vectors of secondary particles formed in a reaction can be related by various combinations, each of which obey the law of conservation of total isospin and of its third projection. For two-particle processes the probabilities of these combinations are determined by the corresponding Clebsh-Gordan coefficients. In the case of multiple-particle processes additional assumptions are required that reduce to postulating a homogeneous probability of intermediate states in isotopic space. A relation is given for the isotopic weight, and a number of reactions involving the generation of strange particles are examined. In spite of the satisfactory agreement of the experimental data with the model for a number of reactions, it is evident that the statistical isospin model can be used only as a rough approximation. (SJR)

1773 N. N. BOGOLYUBOV'S METHOD IN THE PROBLEM OF PAIRING VIBRATIONS AND THE PROBLEM OF EXCLUDING GHOST STATES. Dzholos, R. V.; Kartavenko, V. G.; Rybarska, V. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 20: No. 3, 353-363(Sep 1974). (In Russian).

The N. N. Bogoliubov method in the theory of strong coupling is used for solving the pairing vibration problem. The problem is solved in the harmonic approximation. It is shown that the number of particles is conserved and the spurious solutions are absent. (auth)

1774 RELATIVISTIC WAVE EQUATIONS AND LAGRANGIAN FORMALISM FOR PARTICLES OF ARBITRARY SPIN. Belinicher, V. I. (Inst. of Mathematics, Novosibirsk, USSR). Teor. Mat. Fiz.; 20: No. 3, 320-337(Sep 1974). (In Russian).

Relativistic wave equations for particles of arbitrary spin and parity are obtained. The equations do not require any subsidiary conditions. The fields which satisfy the equations transform according to finite-dimensional reducible representations of the Lorentz group and have the basic and the auxiliary components. The fields obtained possess the minimal possible number of components. The Lagrangian formalism can be formulated on the basis of these equations and different types of interactions can be investigated. As an example, the interaction of a particle of arbitrary spin with an electromagnetic field is considered, and the Feynman rules for this case are obtained. (auth)

1775 INFLUENCE OF INCOHERENCE EFFECTS ON CORRELATIONS IN MULTIPARTICLE PRODUCTION. Karczmarczuk, J. (Uniwersytet Jagiellonski, Krakow (Poland). Instytut Fizyki). Nucl. Phys., B; 78: No. 2, 370-380(25 Aug 1974).

Various models of multiparticle production assume explicitly or implicitly that in high energy collisions the particles are produced by some statistical mechanism. Without adopting any specific model for this mechanism it is shown that the incoherence effects introduced by the statistical superposition of many production sources (resonances, multiperipheral diagrams) together with the coherence of particles originating from the same source lead to strong, positive correlations between produced particles. These correlations possess both short and long range components and can thus account for the observed clustering effects in rapidity distributions and for the broadening of multiplicity distributions. (auth)

Electromagnetic

Refer also to abstract 1947.

1776 (DESY-74/30) DUAL LIGHT-CONE MODEL PREDICTIONS FOR TOTAL AND INCLUSIVE e^+e^- ANNIHILATION. Schierholz, G.; Schmidt, M. G. (Deutsches ElektronenSynchrotron (DESY), Hamburg (F. R. Germany)). June 1974. 16p. Dep. NTIS (US Sales Only) $4.00.

Predictions of a recently proposed dual scaling model for the total and inclusive e^+e^- cross section are discussed taking particular interest in preasymptotic corrections. Good agreement with available data is found. (auth)

1777 (DESY-74/33) NUCLEON RESONANCE PRODUCTION IN e^+e^- ANNIHILATION INTO $N\bar{N}\pi$. Hirshfeld, A. C.; Kramer, G.; Schiller, D. H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Jul 1974. 66p. Dep. NTIS (US Sales Only) $6.50.

The process $e^+e^- \rightarrow N\bar{N}\pi$ is related by crossing to photo- and electroproduction. The quantities of experimental interest in experiments are related with polarized or unpolarized beams to helicity and thence to invariant amplitudes according to a procedure developed previously. The invariant amplitudes are assumed to be dominated, in an appropriate q^2 range, by resonances in the two-body subchannels, of which the nucleon resonances in the pion-nucleon channels are the most important. Using a multipole decomposition of the amplitudes the resonance parameters are related to those measured in photo- and electroproduction. A generalized vector meson dominance model is used for the form factors in order to effect the q^2-continuation. Various cross sections, angular distributions, and Dalitz plots are calculated in order to show how the results depend on the theoretical assumptions. (auth)

1778 (GIFT-3/73) DEEP INELASTIC SCATTERING AND LIGHT CONE. de Azcarraga, J. A. (Grupo Interuniversitario de Fisica Teorica de Altas Energias (GIFT), Zaragoza (Spain)). 1973. 49p. (In Spanish). INIS.

Some recent ideas connected with the experiences of SLAC-MIT on electron deep inelastic scattering are studied. The electron-hadron process is described through the interchange of a virtual photon interacting with the electron according with the quantum mechanics of lower order. (auth)

1779 (KHFTI-73-10, pp 3-6) CONNECTION BETWEEN MATRIX ELEMENT OF DEUTERON ELECTROSPALLATION AND PHASE SHIFTS OF NEUTRON-PROTON SCATTERING. Trubnikov, S. V. (Inst. of Mathematics, Moscow). 1973. (In Russian).

The difficulty of calculating the process of electrospallation of deuterons ed → enp was discussed. The prospects of using the relativistic integral representation for the matrix elements of the fields and currents through the physical scattering matrix were considered. A formula of the amplitudes for the S states of diverging nucleons was given. The cross sections calculated on the basis of this formula were compared with experimental data of other authors. (tr-auth)

1780 ELECTRON-VANISHING WAVE INTERACTIONS AND APPLICATIONS TO THE CHERENKOV EFFECT. Vigoureux, J. M.; Payen, R. (Univ., Reims). Compt. Rend., Ser. B; 278: No. 10, 393-395(4 Mar 1974). (In French).

The spontaneous emission of an electron in uniform motion near to an interface was studied in terms of the quantum theory of vanishing waves. These investigations lead to a better understanding of some of the properties of vanishing waves and to the interpretation of the Cherenkov effect in terms of these waves. (auth)

1781 ELECTROGENERATION OF PIONS NEAR NUCLEON RESONANCES. Ibadov, R. M.; Sadykhov, F. S.; Mukhtarov, A. I. (Azerbaidzhan State Univ., Baku). Dokl. Akad. Nauk Uzb. SSR; No. 4, 28-30(1974). (In Russian).

The form factors of a nucleon and pion, and the transition form factors of the peak of the nucleon-resonance (γNN^*), besides other processes, are determined also by the electrogeneration of pions in the reaction: $e + N \rightarrow e' + N' + \pi$. A general expression with spin correlations being taken into account is presented for the effective cross section of this reaction. Theoretical calculations are compared with experimental data on the electrogeneration of neutral pions near the nucleon resonance N^* (1860) for three form factors — dipole, exponential, and Vataginski. The cross section of the reaction is investigated as a function of the invariant mass W of the system $p\pi^0$ and the square of the transmitted momentum q^2 at an incident electron energy of 4 GeV. In both cases relatively good agreement of theory with experiment is obtained for the exponential and Vataginski form factors. The dipole form factor is not adequate in explaining the experiment in the energy region under consideration. (SJR)

1782 PHOTON-PHOTON SCATTERING WITH SYNCHROTRON RADIATION. Csonka, P. L. (Univ. of Oregon, Eugene); Koelbig, K. S. Phys. Rev., D; 10: No. 1, 251-261(1 Jul 1974).

The number and (energy as well as polarization) spectrum of photons scattered in the forward direction in the reaction center-of-mass frame are calculated when two beams of synchrotron radiation are scattered on each other. The synchrotron radiation is produced by electrons or positrons passing through a locally intense magnetic field which causes a "break" or "wave" in their orbit. Its properties depend on the following parameters: energy and local radius of orbit curvature of the emitting particles, intensity of the emitting current, and angle of emission of the synchrotron radiation. The dependence of the calculated numbers on these parameters is exhibited. (auth)

1783 RESONANCE LEVELS IN ELECTRON-PROTON SCATTERING AND A NONCAUSAL EFFECT. Inagaki, H. (Tokyo Metropolitan Univ.). Lett. Nuovo Cim.; 10: No. 18, 829-834 (31 Aug 1974).

A theoretical curve showing equally spaced peripheral resonances in eN scattering is examined. It is shown that the curve can be obtained if the noncausal part of the invariant amplitude is assumed and explicitly evaluated. (LBS)

1784 ESTIMATE OF THE VALENCE QUARK DOMINANCE REGION, THE CORE QUARK DOMINANCE REGION, AND THE TRANSITION REGION. Kim, B. R.; Rodenberg, R. (Technische Hochschule, Aachen). Lett. Nuovo Cim.; 10: No. 18, 793-798 (31 Aug 1974).

Estimates are made of the valance quark dominance region, the transition region, and the core quark dominance region by using the existing data of deep inelastic electron-nucleon scattering. (LBS)

1785 PHYSICS OF DEEP INELASTIC PHENOMENA. Altarelli, G. (Univ., Rome). Riv. Nuovo Cim.; 4: No. 3, 335-397(Sep 1974).

A concise review is given on the subject of deep inelastic phenomena. The basic definitions and experimental data are recalled in Sections 1 and 2. Sections 3 to 9 contain a summary of the theoretical background, with special emphasis on new developments, such as asymptotic freedom. Sections 10 and 11

are devoted to a discussion of recent data from neutrino experiments. Section 12 completes the discussion of phenomenological implications of gauge theories of weak and electromagnetic interactions in deep inelastic processes. Section 13 is devoted to deep inelastic processes with one hadron detected in the final state. Section 14 is a brief discussion of lepton pair production in hadron-hadron collisions. (LBS)

1786 AUTO-MODEL BEHAVIOR OF DEEP INELASTIC SCATTERING ON MASSLESS TARGET PARTICLES. Wiczorek, E.; Doerfel, B.; Krasnikov, N. V.; Matveev, V. A.; Robashik, D.; Chetyrkin, K. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 20: No. 3, 308-314(Sep 1974). (In Russian).

Studying the scattering of virtual photons on massless protons a proof of the causality for the form factors V_i and W_i is given. The consequences of exact dilatation invariances are investigated in the framework of the Dyson–Jost–Lehmann representation. (auth)

1787 e^+e^--ANNIHILATION INTO HADRONS AND UNIFIED THEORIES. Fritzsch, H.; Minkowski, P. (California Inst. of Tech., Pasadena (USA)). Phys. Lett., B; 51: No. 2, 161-164 (22 Jul 1974).

It is argued that unified gauge theories of weak, electromagnetic and strong interactions lead naturally to the introduction of new hadronic constituents which carry both color and electric charge and are colored counterparts of the W-bosons mediating the weak interactions. Consequences for e^+e^--annihilation and deep inelastic scattering are discussed. (auth)

1788 VECTOR MESONS AND (VIRTUAL) NUCLEAR OPTICS. Greco, M. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati); Srivastava, Y. N. (Northeastern Univ., Boston, Mass. (USA). Dept. of Physics). Phys. Lett., B; 51: No. 2, 172-176(22 Jul 1974).

Nuclear photoproduction and inelastic electron-nucleus scattering at high energies are investigated in the framework of a scaling model of electromagnetic interactions which has been recently proposed. No shadowing is predicted to take place for large q^2. The results are in agreement with the available experimental data. (auth)

1789 PARTON MODEL PREDICTIONS FOR TWO-PARTICLE CORRELATIONS IN e^+e^- ANNIHILATION. Walsh, T. F. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)); Zerwas, P. (Technische Hochschule Aachen (F. R. Germany). 3. Physikalisches Inst.). Nucl. Phys., B; 77: No. 3, 494-508(11 Aug 1974).

The parton model predicts a jet structure for e^+e^- annihilation into hadrons. This is obscured at low energies by the presence of finite transverse momentum effects. A study of $e^+ + e^- \to h_1 + h_2 + X$, where at least one hadron is near the kinematical boundary is suggested; this defines a jet axis. Numerous predictions for correlations among mesons follow from Feynman's parton fragmentation suggestion. Sum rules which check for the quantum numbers of the partons are also given. (auth)

1790 S-MATRIX AND UNITARITY BOUNDS FOR THREE-CHANNEL SYSTEMS, WITH APPLICATION TO LOW-ENERGY PHOTOPRODUCTION OF PIONS FROM NUCLEONS. Waldenstroem, S. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). Nucl. Phys., B; 77: No. 3, 479-493(11 Aug 1974).

A parametrization of the S-matrix for three-channel systems is given, where the unitarity bounds on the free parameters are stated explicitly. The free parameters are directly related to measurable quantities. The results are applied to low-energy photoproduction of pions from nucleons, and lower bounds for the electric dipole amplitudes E_{0+} for π^0 production are obtained. These lower bounds follow without using the Fermi-Watson final-state theorem. (auth)

1791 CURRENT AND CONSTITUENT QUARKS: THEIR IMPLICATIONS FOR RESONANCE EXCITATIONS POLARIZED AND UNPOLARIZED INELASTIC STRUCTURE FUNCTIONS. Close, F. E. (European Organization for Nuclear Research, Geneva (Switzerland)); Osborn, H. (Caltech, Pasadena, USA); Thomson, A. M. (Durham Univ. (UK)). Nucl. Phys., B; 77: No. 2, 281-308(4 Aug 1974).

The transformation between constituent and current quarks is discussed and applied to the calculation of matrix elements for nucleon to resonance transitions induced by arbitrary currents belonging to an octet. In particular, previous results on πN and γN transitions are subsumed while weak interactions ($\Delta Q = 0$ or 1) and longitudinal photon induced transitions are discussed for the first time. The implications of a non-trivial Melosh transformation upon previous calculations in quark parton models of the non-diffractive component of the deep inelastic structure functions are discussed. The magnitudes of the unpolarized structure functions are found to be unchanged but for the polarized structure functions significant corrections to previous calculations are discovered. In particular it is found that it is not necessary that the polarization asymmetry A_{γ^p} be positive in the deep inelastic region. This approach is valid for all Q^2, even for photoproduction, and is not restricted to deep inelastic scattering in contrast to earlier parton model calculations. The saturation of various current algebra sum rules is discussed. (auth)

1792 MULTIPARTICLE PRODUCTION AND THE ASYMPTOTIC BEHAVIOUR OF FORM FACTORS. Peccei, R. D. (Science Research Council, Chilton (UK). Rutherford Lab.). Phys. Lett., B; 51: No. 3, 279-282(5 Aug 1974).

Physical arguments are presented, based on local compensation of quantum numbers, which suggest that asymptotically the ratios of the pion form factor to the kaon form factor and to the nucleon form factor (F_1) are in the same proportion as the ratios of hadronic charge exchange amplitudes are to strangeness exchange amplitudes and to baryon exchange amplitudes. Namely it is found that $F_\pi(t)F_K(t) \sim |t|^{\alpha\rho-\alpha K^*}$ and $F_\pi(t)F_1(t) \sim |t|^{\alpha\rho-\alpha N}$. Speculations on the asymptotic behavior of the total cross sections $e^+e^- \to$ hadrons are also presented. (auth)

1793 A PHENOMENOLOGICAL ANALYSIS OF PION PHOTOPRODUCTION. Metcalf, W. J.; Walker, R. L. (California Inst. of Tech., Pasadena (USA)). Nucl. Phys., B; 76: No. 2, 253-289 (11 Jul 1974).

Data on single pion photoproduction in the resonance region have been fitted with a model used previously by one of the authors. In updating the older fit a considerable amount of new data has been incorporated, the energy range has been extended to a total c.m. energy W = 2.0 GeV, and the procedure followed in making the fit has been changed so as to make greater use of the computer. In the model used for the analysis the pion photoproduction amplitude is composed of three parts: (1) the electric Born approximation, (2) Breit-Wigner resonances, and (3) additional "background" contributions in the lower partial waves. The electromagnetic couplings of many of the πN resonances with masses below 2 GeV have been determined in the analysis, and the results are compared to quark model predictions. (auth)

1794 SOLUTION OF COULOMB PROBLEM BY LAPLACE TRANSFORM. Engefield, M. J. (Monash Univ., Clayton, Australia). J. Math. Anal. Appl.; 48: No. 1, 270-275(Oct 1974).

The bound state energies and scattering phase shifts for the Coulomb potential are obtained from both the Schroedinger and Dirac equations by taking a Laplace transform. Inversion of transforms is not required, and the nonrelativistic eigenvalue problem is solved without even obtaining the transforms explicitly. The nonrelativistic scattering amplitude appears after solving a first-order differential equation. (auth)

1795 CANONICAL FORMULATION OF RELATIVISTIC HYDRODYNAMICS. Bialynicki-Birula, I. (Univ., Warsaw); Iwinski, Z. Rep. Math. Phys.; 4: 139-151 (1973).

Canonical formulation of the relativistic theory of perfect fluids is given. As an introduction to this subject the canonical formalism for charged particles interacting with electromagnetic field is briefly discussed. Relativistic hydrodynamics is studied in several versions including hydrodynamics of charged fluids coupled to the electromagnetic field and ultrarelativistic hydrodynamics. Ultrarelativistic hydrodynamics is shown to be conformally invariant and several implications of conformal symmetry are discussed. (auth)

1796 SOME FEATURES OF THE SINGLE PION PHOTOPRODUCTION AMPLITUDES CONSTRUCTED FROM RESONANCES. Bando, M. (Kyoto Univ.); Nakamura, T.; Sugimoto, H.; Inagaki, T. Progr. Theor. Phys. (Kyoto); 51: No. 4, 1094-1102 (Apr 1974).

The behavior of the amplitudes which are constructed from resonances in the single pion photoproduction processes is shown for each t-channel isospin state. The contributions of the unnatural-parity meson exchange are also shown. (auth)

1797 EXISTENCE OF DRESSED ONE ELECTRON STATES IN A CLASS OF PERSISTENT MODELS. Forehlich, J. (Eidgenoessische Technische Hochschule, Zurich). Fortschr. Phys.; 22: No. 3, 150-198 (1974).

The dynamics of a class of simple models (so called persistent models) including Nelson's model is studied. These models describe conserved, nonrelativistic, scalar electrons interacting with

neutral, scalar bosons. Special attention is paid to the so called one particle problem: the existence of dressed one-electron states – corresponding to an isolated one particle shell in the spectrum of the energy-momentum operator (H,P) – is established for the models with massive bosons and the ones with bosons of rest mass zero and an infrared cutoff in the interaction. (auth)

1798 SUPERGAUGE ALGEBRA AND ELECTROMAGNETIC INTERACTION OF THE DUAL PION MODEL. II. Konisi, G. (Kwansei Gakuin Univ., Nishinomiya, Japan); Matsuda, S.; Saito, T. Progr. Theor. Phys. (Kyoto); 51: No. 4, 1172-1182(Apr 1974).

The electromagnetic problem of the Neveu-Schwarz model was previously considered on the basis of the supergauge algebra and the photon gauge substitution. The theory is applied to magnetic moments of the N-S model, and a general formula of magnetic moments with the universal g-factor g(J) = 2 for all the states is found. The dual amplitude of the γ-π scattering is also calculated where the tachyon of the p-trajectory decouples. Finally proof is given that the system is free from ghost states. The new gauge conditions previously obtained are crucial for proving the no-ghost theorem. (auth)

1799 NUCLEAR CASCADE. II. Oda, H. (Kobe Univ., Japan). Uchusen Kenkyu; 17: No. 4, 476-483(Feb 1973). (In Japanese).

From Symposium on charged particles and cosmic radiation; Hamamatsu, Japan (Dec 1971).

Effect of decay in nuclear cascade is discussed. A recurrence formula for $\pi_k(E)$ in case of including decay particles such as pions is given. The $\pi_k(E)$ is also obtained from $\tilde{P}k(s)$ by the inverse Mellin transformation. The meaning of symbols was given previously in "Nuclear Cascade (I)". An approximate calculation of $\tilde{P}k(s)$ was performed. The effect of decay was examined, and is larger for the lower energy part in energy spectrum. Formulas for log-Gauss-distribution are discussed. A case different from $\phi_1 = \phi_2 = \ldots\ldots = \phi$ is discussed. Values of ϕ are given for the case that parent particles are nucleons and pions. In case of the nucleons, survived and secondary particles are produced in nuclear interaction, whereas only secondary particles are produced in case of the pions. A lineage diagram of each generation in nuclear cascade is presented, and formulas for T, N, $\tilde{P}$ are presented. In case of different mean free path of nucleons from that of pions, imaginary particles were introduced, and the present approach was performed. Generalization of φ (E, Eo) is discussed. (Kato, T.)

1800 e^+e^- ANNIHILATION INTO HADRONS IN QUANTUM FIELD THEORY. Cheng, H.; Mandula, J. (Department of Mathematics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. Lett. 33: No. 11, 667-670 (9 Sept 1974).

Quantum field theory is shown to give an energy-dependent $R = \sigma(e^+e^- \rightarrow \text{hadrons})/\sigma(e^+e^- \rightarrow \mu^+\mu^-)$, as a result of creation of slow particles in the c.m. system. A simple model which predicts power growth for R is given, and further experimental consequences are discussed. (auth)

1801 ELECTROMAGNETIC EFFECTS FOR THE PROCESSES $\pi^+p \rightarrow \pi^+\pi^+n$. Chen, B. C. J. Notre Dame, IN; Univ. of Notre Dame (1974). 101p. University Microfilms Order No. 74-21,145.

Thesis (Ph. D.).

The electromagnetic effects for the processes $\pi^+p \rightarrow \pi^+\pi^+n$ include the "real" radiative corrections, the "imaginary" radiative corrections, the relative phases between the strong and various Coulomb Born amplitudes, and the Coulomb Born amplitudes themselves. The techniques developed by Yennie and his coworkers were used to calculate the dominant "real" radiative corrections which will modify the magnitude of the observable differential cross section and the relative phases which will provide the interference effects between the purely strong and the electromagnetic amplitudes. The effective cancellations of various Born amplitudes were studied numerically. The implications of the results are discussed for the usual Chew-Low extrapolation scheme which is often used to obtain the $\pi\pi$ elastic cross section from $\pi N \rightarrow \pi\pi N$ production data. Some useful five particle kinematics, some integrals, and some details of the calculations are presented. (Diss. Abstr. Int., B)

1802 DERIVATION OF EINSTEIN'S POSTULATE REGARDING THE ENERGY OF LIGHT QUANTA FROM A MORE ELEMENTARY POSTULATE AND SPECIAL RELATIVITY. Lessen, M. (Univ. of Rochester, NY). Found, Phys ; 4: No. 3, 417-419 (Sep 1974).

A thought experiment is presented which demonstrates that the Einstein extended Planck postulate being Lorentz invariant is derivable from special relativity and a more elementary postulate such as $E = E(\omega)$. (JFP)

1803 RELATIVISTIC PARTICLE IN PROBABILISTIC PHYSICS. Mayants, L. S. (Inst. of Elemento-Organic Compounds, Moscow). Found. Phys.; 4: No. 3, 335-353(Sep 1974).

Some problems relating to the probabilistic description of a free particle and of a charged particle moving in an electromagnetic field are discussed. A critical analysis of the Klein–Gordon equation and of the Dirac equation is given. It is also shown that there is no connection between commutativity of operators for physical quantities and the existence of their joint probability. It is demonstrated that the Heisenberg uncertainty relation is not universal and explained why this is so. A universal uncertainty relation for canonically conjugate coordinates and momenta is suggested. (auth)

1804 MINIMUM PHOTON REST MASS: USING PLANCK'S CONSTANT AND DISCONTINUOUS ELECTROMAGNETIC WAVES. Honig, W. M. (Univ. of Western Australia, Nedlands). Found. Phys.; 4: No. 3, 367-380(Sep 1974).

Reasons for taking $\frac{1}{2}h/c^2$ in cgs units as an equivalent in grams for the photon "rest mass" are given. Its numerical value of 3.68×10^{-48} g corresponds to the minimum mass equivalent energy for one half-cycle of an electromagnetic dipole field distribution, which is discontinuous. For the fluid models that are discussed, this field distribution corresponds somewhat to a hydrodynamic toroidal vortex which is stationary—if one uses toroidal coordinates and assumes that the ring origin has the radial velocity c, that the gauge is defined by the ring origin diameter, and that free space is represented by a two-fluid model (the fluids oppositely charged). There are mappings which can transform such toroidal entities (photons) into spherical ones. The toroidal entities are possible candidates for the role of "hidden variables." (auth)

1805 RENORMALIZATION GROUP REPRESENTATION AND THE GELL-MANN–LOW AND CALLAN–SYMANZIK EQUATIONS FOR THE PHOTON PROPAGATOR. Jouvet, B. (International Centre for Theoretical Physics, Trieste, Italy). Nuovo Cim., 23A: No. 4, 621-656(21 Oct 1974).

Admitting that the photon propagator is a representation of the renormalization group, it is first determined which specific property of QED is implied by the existence of the G-M–L and C-S equations in perturbation theory. After elucidating the different roles played by the G-M–L and C-S functions, ψ and β, in the determination of the photon propagator, the conditions are indicated under which $\beta(\alpha)$ is or is not related to its asymptotic behavior. Taking a global point of view, it is shown that the nullity of the second member of the C-S equation at infinity is implied by unitarity, except in one special case. The global expression of $\beta(\alpha)$ leads one to classify the photon propagators into two different classes. In the first, the G-M–L equation gives a faithful representation of their asymptotic behavior. In the second, which is studied in detail, the bare charge is a function of α, $\beta(\alpha) \equiv 0$, and the perturbation theory determines fallacious β and ψ functions. (auth)

1806 ANOTHER MODEL FOR THE VIOLATION OF SCALING. Venturi, G.; Zerbini, S. (Univ., Bologna). Lett. Nuovo Cim.; 11: No. 4, 257-260(28 Sep 1974).

A simple approach is presented for the violation of the expected scaling law in e^+e^- annihilation into hadrons. This approach is based on the quark model which, while maintaining the usual quark model results for deep inelastic lepton production off nucleons leads to a constant cross section for the studied process. (JFP)

1807 COULD PION ELECTROPRODUCTION BE A TEST OF CURRENT–CURRENT LIGHT-CONE COMMUTATORS. Burnel, A. (Univ., Liege). Lett. Nuovo Cim.; 11: No. 4, 301-304 (28 Sep 1974).

The amplitude for the process $\gamma + N \rightarrow \pi + N$ interactions where the pion may be off mass shell is considered in order to show that the use of a partial integration to generate a current–current commutator whose light cone behavior is taken from SU(3) × SU(3) and scaling in deep inelastic inclusive electroproduction is completely irrelevant for the study of pion electroproduction and related processes. (JFP)

1808 IS THERE EVIDENCE FOR LARGE ANOMALOUS DIMENSIONS? Nachtmann, O. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). Nucl. Phys., B; 78: No. 3, 455-467 (4 Sep 1974).

Some popular belief about the implications of scaling in deep inelastic electron nucleon scattering is destroyed. Certain mo-

ments similar to the Cornwall–Norton sum rules but which give at all values of Q^2 precisely the coefficient functions occurring in the Wilson expansion of the product of two electromagnetic currents are computed. Data in the range $1 \leq Q^2 \leq 10$ GeV^2 seem to favor large anomalous dimensions. If canonical dimensions are insisted upon, it has to be concluded that asymptotia has not yet set in in this Q^2 range. (auth)

1809 THE SPIN-STRUCTURE FUNCTION FROM ELECTRON-POSITRON ANNIHILATION. Gatto, R. (Rome Univ. (Italy). Istituto di Fisica); Vendramin, I. (Padua Univ. (Italy). Istituto di Fisica). Nucl. Phys., B; 78: No. 3, 413-434(4 Sep 1974).

Spin structure functions are at least as important as the spin-averaged $W_1(q^2,\nu)$ and $W_2(q^2,\nu)$. In annihilation they can be measured provided longitudinal beam polarization is obtainable. A complete study is given of the problem including derivation of positivity conditions and ensuing restrictions. (auth)

1810 STRONG VACUUM POLARIZATION AND SELF-DAMPING OF e^+e^- ANNIHILATION. Gatto, R. (Rome Univ. (Italy). Istituto di Fisica). Phys. Lett., B; 51: No. 4, 371-375(19 Aug 1974).

If the hadronic contribution to vacuum polarization, which is proportional to the ratio of e^+e^- annihilation into hadrons to that into $\mu^+\mu^-$ rises asymptotically as a power $\beta > \frac{1}{2}$ of the squared four-momentum, the ratio $\sigma(e^+e^- \to \text{hadrons})/\sigma_{\text{point}}$ [$\sigma_{\text{point}} = (4\pi\alpha^2)/(3s)$] is bound to be less than $-(3\ \text{tg}\pi\beta)/(8\alpha)$ and this limit is approached sooner for higher β. Other models of vacuum polarizations are also considered together with their possible origins and implications. (auth)

1811 POSSIBLE RELATION BETWEEN SCALED HADRONIC MULTIPLICITY DISTRIBUTION IN pp COLLISIONS AND $e^+e^- \to \gamma \to$ HADRONS. Barshay, S.; Yamaguchi, Y. (State Univ. of New York, Stony Brook (USA). Inst. for Theoretical Physics). Phys. Lett., B; 51: No. 4, 376-378(19 Aug 1974).

An impact-parameter representation of the empirical scaled charged-prong multiplicity distributions in high-energy pp collisions leads to the speculation that a corresponding multiplicity distribution in $e^+e^- \to \gamma \to$ hadrons should approximately scale and be more sharply peaked about a larger average multiplicity than the pp case. (auth)

1812 ω PHOTOPRODUCTION OFF NEUTRONS: A TEST OF A_2 PERIPHERALITY. Barker, I. S.; Gabathuler, E.; Storrow, J. K. (Science Research Council, Daresbury (UK). Daresbury Lab.). Nucl. Phys., B; 78: No. 3, 515-524(4 Sep 1974).

In order to determine whether A_2 exchange is peripheral or not it is advocated that $d\sigma/dt(\gamma n \to \omega n)$ is measured and compared with $d\sigma/dt(\gamma p \to \omega p)$. If A_2 exchange is peripheral then it is suggested that there is a large "cross-over effect" between the two reactions which should be easily detectable. A simple model calculation of the effect is given. (auth)

1813 CREATION OF ELECTRON-POSITRON PAIRS AND THEIR ANNIHILATION IN A SUPERSTRONG MAGNETIC FIELD. Sokolov, A. A.; Ternov, I. M.; Borisov, A. V.; Zhukovskii, V. Ch. (Moskovskij Gosudarstvennyj Univ. (USSR)). Phys. Lett., A; 49: No. 1, 9-10(12 Aug 1974).

The probability of creation and annihilation of pairs in a superstrong magnetic field $H \gtrsim H_0 = m^2c^3/\hbar e \sim 4.41 \times 10^{13}$ G is obtained. It is shown that in such a field the ground state of electrons (or positrons) provides considerable contribution to the total probability of the process. (auth)

1814 SCALING OF THE LONGITUDINAL PHOTON CROSS SECTION AND ITS RELATION TO MASSLESS QUARKS. Heimann, R. L. (Cambridge Univ. (UK). Cavendish Lab.). Nucl. Phys., B; 78: No. 3, 525-540(4 Sep 1974).

It is shown that the scaling function $r(\omega)$ of the law $\nu\sigma_L/M\sigma_T \to r(\omega)$ (as predicted in the quark model light-cone current algebra) can be uniquely calculated from the scaling function of νW_2 when there is no $\delta(x^2)$ light-cone singularity one unit below the leading $\delta'(x^2)$ one specified by that algebra. This relation between scaling functions requires the effective quark mass to vanish; the relation is used as a test for the presence of the non-leading $\delta(x^2)$ singularity. New experimental data, that do show scaling for $\nu\sigma_L/\sigma_T$, disagree with this relation for $r(\omega)$. This is regarded as suggestive of a finite quark mass. Other considerations support this, and the parton model estimate from the data that the quark transverse mass is very close to one third of the mass of the nucleon. (auth)

1815 CHARGED SPIN-ONE PARTONS. Cleymans, J.; Komen, G. J. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 78: No. 3, 396-402(4 Sep 1974).

The possibility that point-like charged spin-one partons are responsible for the present constancy of the e^+e^- annihilation cross section into hadrons is investigated. (auth)

1816 RESTRICTIONS ON THE ANOMALOUS DIMENSIONS FROM ANALYSIS OF DEEP INELASTIC EP SCATTERING DATA. Bilenkaya, S. I.; Hristova, E. H.; Stamenov, D. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). Nucl. Phys., B; 79: No. 3, 422-430(25 Sep 1974).

The SLAC-MIT data on deep inelastic ep scattering are analyzed. In the expression for the structure function νW_1 a scaling breaking term due to possible anomalous dimensions is added. It is shown that the data are fitted well by different parametrizations of $R \equiv \sigma_L/\sigma_T$. It is also shown that the presently available SLAC-MIT data do not exclude anomalous dimensions. The value of the anomalous dimensions strongly depends on the parametrization of R. (auth)

1817 THE ELECTROMAGNETIC FORM FACTOR OF THE PION. Volkov, M. K.; Pervushin, V. N. (Joint Inst. for Nuclear Research, Dubna (USSR)). Phys. Lett., B; 51: No. 4, 356-358 (19 Aug 1974).

The superpropagator method is used to calculate the electromagnetic form factor of the massive pion in a theory of the chiral type. The calculated values for the pion radius $\sqrt{\langle r^2 \rangle} \sim 0.65$ fm and the scattering wavelength, $a| = 0.031$ and the absolute values for the form factor in the threshold energy region are in satisfactory agreement with the experimental data. (auth)

1818 WEAK AND ELECTROMAGNETIC FORM FACTORS OF HADRONS. Gourdin, M. (Paris-6 Univ., 75 (France). Div. de Physique Theorique). Phys. Rep.; 11: No. 2, 29-98(Jun 1974). 191 refs.

The elastic electromagnetic and weak form factors are studied for nucleons, π and K mesons. Experimental data as well as theoretical approaches are reviewed. (auth)

1819 SOME REMARKS ON ELECTRON–QUARK INTERACTIONS. Schlereth, H. (Technische Hochschule, Aachen). Lett. Nuovo Cim.; 11: No. 6, 337-341(12 Oct 1974).

It was previously shown in a two-component model of electron–positron hadronic annihilation that the differential cross sections for $e^+e^- \to h_1 \ldots h_nX$ can in the region $x_i = 2E_i/\sqrt{s} < \frac{1}{2}$ ($\sqrt{s}$ = total cms energy, E_i = energy carried by the i-th hadron) can be written in a given hadronic scaling form. Using preliminary data for the single-particle distribution, it can be demonstrated that the given form is valid within an error of ±10% in the interval $x \approx 0.2$ to 0.3. The validity of this relation at smaller x values may need higher energies, which will become available at SPEAR II. (JFP)

1820 HADRON–QUARK RECIPROCITY AND AN APPLICATION TO HADRON DISTRIBUTIONS IN PHOTON–PHOTON SCATTERING. Schlereth, H. (Technische Hochschule, Aachen). Lett. Nuovo Cim.; 11: No. 6, 342-344(12 Oct 1974).

The discussion of the hadron–quark reciprocity for photon–photon scattering covers the average multiplicities, and the restricted form of the general decomposition into valence and core parts. Also the two-particle distribution is considered. (JFP)

1821 INTERPRETATIONS OF RECENT DATA $\sigma(e^+e^- \to$ HADRONS). Minami, S.; Terada, M. (Osaka City Univ.). Lett. Nuovo Cim.; 11: No. 5, 305-308(5 Oct 1974).

It was recently shown experimentally that the cross sections for $e^+e^- \to$ hadrons in a region from $s = 16$ to 25 GeV^2 are consistent with a constant cross section of $(2.5 \pm 0.5)(10)^{-32}$ cm^2. Two different models were proposed previously to explain this result. These models are studied from a phenomenological viewpoint, and the possibility is pointed out that one can exclude one of them if future experiments give some information about the following a) or b): a) in elastic e^+e^- scattering at $\sqrt{s} =$ (50 to 70) GeV, whether or not there is a large difference between the observed value of the differential cross sections at 90° (or 180°) and the theoretical prediction based on the Born approximation; b) whether the average multiplicity in inelastic e^+e^- scattering at high energy has log s-dependence or not. (JFP)

1822 THE PION RADIUS. Adylov, G. T.; Aliev, F. K.; Bardin, D. Yu.; Gajewski, W.; Ion, I.; Kulakov, B. A.; Micelmacher, G. V.; Niczyporuk, B.; Nigmanov, T. S.; Tsyganov, E. N. (Joint Inst. for Nuclear Research, Dubna (USSR)). Phys. Lett., B; 51: No. 4, 402-406(19 Aug 1974).

The pion radius has been measured by direct scattering of 50 GeV negative pions from stationary electrons in a hydrogen target. The square of the radius is found to be $\langle r_\pi^2 \rangle = (0.61 \pm 0.15)$ fm^2. (auth)

1823 A NEW UNITARITY BOUND ON e^+e^- ANNIHILATION. Cabibbo, N.; Karl, G.; Wolfenstein, L. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Lett., B; 51: No. 4, 387-389(19 Aug 1974).

Unitarity relates σ_h the electron-positron annihilation cross section into hadrons and σ_μ the cross section into muon pairs. This relation provides much more restrictive bounds on σ_h than the simple unitarity bound, for the case in which the hadronic channels dominate the total annihilation cross section. (auth)

1824 ANALYSIS OF π^0 PHOTOPRODUCTION AT INTERMEDIATE AND HIGH ENERGIES. Barker, I. S.; Donnachie, A.; Storrow, J. K. (Science Research Council, Daresbury (UK). Daresbury Lab.). Nucl. Phys., B; 79: No. 3, 431-469(25 Sep 1974).

An amplitude analysis of π^0 photoproduction is carried out in the t range $-0.2\ (GeV/c)^2 \geq t \geq -0.7\ (GeV/c)^2$ using finite energy sum rules and fixed t dispersion relations and fitting all available data from 3 GeV upwards. All four FESRs are fitted in contrast to previous work where it was assumed that one of the unnatural parity amplitudes (F_4) is zero and its FESR was ignored. Using the evidence of the relevant FESR it is found that it is not negligible, particularly at lower energies, but is found to have the energy dependence typical of an amplitude corresponding to exotic exchange, i.e., very steep energy dependence at the lower energies flattening out at higher energies. The fit is extrapolated below 3.0 GeV and experimental predictions given. In particular, predictions for possible double polarization measurements are discussed. The amplitudes at 4 GeV are presented and they show that the dual absorption model gives the correct zero structure for the imaginary parts of spin-flip amplitudes but not for the no-flip amplitudes. (auth)

1825 A STUDY OF SHADOWING IN HEAVY NUCLEI. Cocho, G.; Leon, J. (International Centre for Theoretical Physics, Trieste (Italy)); Gregorio, M. (La Plata Univ. Nacional (Argentina)); Rotelli, P. (Queen Mary Coll., London (UK)). Nucl. Phys., B; 78: No. 2, 269-292(25 Aug 1974).

The theory for shadowing of real and virtual photons in heavy nuclei is presented in the context of the generalized vector-meson dominance (GVMD) model. In particular, the consequence of including off-diagonal element in GVMD is investigated. It is found that including a positive real/imaginary part in the virtual photon-hadron amplitude considerably improves agreement with experiments. Such an important real part is consistent with the energy dependence of the vector-meson electroproduction data. These data also exhibit a feature which may be called the decoupling of the pomeron as a function of q^2, the photon mass. The relation to a similar feature of the pure hadronic interactions is discussed. (auth)

1826 SOLUTIONS OF THE MULTICHANNEL UNITARITY EQUATIONS DESCRIBING THE ADDITION OF A RESONANCE AND BACKGROUND: APPLICATION TO A POLE MODEL OF PHOTOPRODUCTION. Olsson, M. G. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 78: No. 1, 55-76(18 Aug 1974).

Addition of a resonance and background in the multichannel case is investigated. The generalization of a method, which correctly unitarizes a pole model of πN elastic scattering, is found. Application is made to photoproduction, showing that a pole model can account for the resonant multipoles in the Δ region. The $\gamma N\Delta$ coupling constant required is nearly that predicted by the quark model. (auth)

Weak

1827 (COO-1764-202) AXIAL VECTOR ANOMALY IN K_L AND RELATED DECAYS. Gavrielides, A. (Minnesota Univ., Minneapolis (USA). Dept. of Physics and Astronomy). Jun 1974. Contract AT(11-1)-1764. 49p. Dep. NTIS $5.50.

The $K_L \to 2\gamma$ decay is examined in the context of gauge models of weak and electromagnetic interactions. It is shown that the decay is possible because of the existence of an anomaly in the divergence of the axial vector current that transforms like λ_8 under SU(3). The existence of such an anomaly is first shown in an SU(2) × U(1) gauge model containing only the familiar quarks, and then generalized and calculated for the realistic case of the SU(4) model of Glashow, Iliopoulos, and Maini. The $K_L \to 2\gamma$ rate is obtained as a function of the amount of SU(4) breaking, which is determined to be of the order of 1.5 GeV^2. In addition, the $K_L \to \bar{\mu}\mu$ decay is examined within the context of the above models and is shown to be sufficiently suppressed. Moreover, the examination of $K_S \to \pi^+\pi^-$ decay and the $K_L - K_S$ mass difference leads to an interesting relation independent of mass parameters. Also, in the case of the SU(4) model, the calculation of those processes leads to the determination of the quark mass parameters. (auth)

1828 BOUNDS ON ELASTIC SCATTERING AMPLITUDES OF WEAKLY INTERACTING PARTICLES. Vernov, V. S. (Inst. of Nuclear Research, Moscow). Teor. Mat. Fiz.; 20: No. 3, 315-319(Sep 1974). (In Russian).

Bound on maximal growth of the sum of the ve and $\bar{\nu}\bar{e}$ elastic forward scattering amplitudes is obtained. (auth)

1829 INCLUSIVE MUON PRODUCTION REACTIONS AS A TEST OF NEUTRAL CURRENTS. Korthals-Altes, C. P.; Perrottet, M.; de Rafael, E. (Centre National de la Recherche Scientifique, 13-Marseille (France). Centre de Physique Theorique). Nucl. Phys., B; 76: No. 3, 549-573(18 Jul 1974).

With right and left handed polarized muons scattering on an unpolarized target, possible asymmetries of inclusive cross sections induced by neutral weak currents are discussed. Using general positivity arguments, rigorous upper bounds to the asymmetries are derived. Numerical estimates of the bounds are already possible if use is made of the branching ratios $NC/CC)_{\nu,\bar{\nu}}$ observed in the CERN Gargamelle bubble chamber. Upper and lower bounds to the asymmetries, specific to the Weinberg-Salam model, are also discussed. (auth)

1830 DETERMINATION OF THE α DECAY PARAMETER OF Ω^-. Kocher, D. J.; Wernhard, K. L. (Innsbruck Univ. (Austria)). Phys. Lett., B; 51: No. 2, 193-194(22 Jul 1974).

A determination of the α decay parameter of the $\Omega^- \to K^-\Lambda$ decay mode on the basis of fifteen Ω-events from K^-p interactions at 10 GeV/c yields the value $\alpha_\Omega = -0.66^{+0.36}_{-0.31}$. (auth)

1831 POSITIVITY BOUNDS ON TOTAL NEUTRINO CROSS-SECTIONS AS MEANS TO RESTRICT THE MASS OF THE INTERMEDIATE BOSON. Grosse, H.; Pietschmann, H. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). Phys. Lett., B; 51: No. 2, 165-168(22 Jul 1974).

Positivity restrictions on the structure functions for deep inelastic lepton scattering are used to derive upper and lower bounds for total neutrino cross-sections. Comparison with experiment leads to a lower limit for the mass of the (charged) intermediate vector boson. (auth)

1832 CABIBBO UNIVERSALITY, RENORMALIZATION, AND THE Z VECTOR BOSON MASS. Roos, M. (Helsinki Univ. (Finland). Dept. of Nuclear Physics). Nucl. Phys., B; 77: No. 3, 420-428(11 Aug 1974).

Using the most recent data on the ft-values of the $0^+ \to 0^+$ decays ^{14}O, ^{38m}Al and ^{34}Cl, the hyperon β-decays, and the K^+_{e3} rate, the following limits are determined (95% confidence level): Cabibbo angle $\sin\theta > 0.226$, intermediate vector boson mass $M_Z > 25$ GeV (for four quarks with integral charges) or $M_Z > 110$ GeV (three colored quartets), K^+_{e3} form factor $f_+(0) < 0.98$. (auth)

1833 SOME REMARKS ON THE HIGGS MECHANISM. Lopuszanski, J. (Univ., Wroclaw). Fortschr. Phys.; 22: No. 5, 295-309 (1974).

It is shown that at least one of the auxiliary one-component fields in the Higgs model – the field ϕ – is not a Lorentz scalar and that it is probably not local with respect to the current. The conclusion is that one cannot prescribe to the field ϕ a direct physical meaning. In case ϕ is not local with respect to the current it is likely that the zero eigenvalue of the mass operator does not appear in the theory at all. In case ϕ is quasilocal with respect to j_μ, such an eigenvalue appears at least in the original model and the mass spectrum can be different for different versions of the model. It is conjectured that this can be explained with help of the theory of unitarily inequivalent representations. The difficulty in translating into the quantal language the classical procedure leading from the original model to the variant of unitary gauge is displayed. It is hoped that with help of unitarily inequivalent representations this difficulty can be resolved. We exhibit the fact that in the Higgs model the whole gauge group does not have a direct physical meaning, in contradistinction to electrodynamics, where the local gauge group only has no physical significance.

1834 MODEL-INDEPENDENT ANALYSIS OF THE NEUTRAL-CURRENT INTERACTION IN THE INCLUSIVE NEUTRINO REACTIONS. Rajasekaran, G.; Sarma, K. V. L. (Tata Inst. of Fundamental Research, Bombay). Pramana; 3: No. 1, 44-55(Jul 1974).

On the basis of some general assumptions on the deep inelastic structure functions, such as scaling and chiral symmetry, the values of $\{(H_V^3)^2 + (H_A^3)^2\} + \eta\{(H_V^0)^2 + (H_A^0)^2\}$ and $H_V^3 H_A^3 + \eta H_V^0 H_A^0$ where

$H_V^{1,0}$ and $H_A^{1,0}$ are the four coupling constants characterizing the hadronic neutral current and η is the ratio of the isoscalar to isovector structure functions are determined. General expressions are given for the kinematical averages $\langle\nu\rangle$ and $\langle Q^2\rangle$ for the neutral-current reactions in terms of the coupling constants. This analysis does not depend on the validity of the quark-parton model. (auth)

1835 SOME THEORETICAL CONSIDERATIONS ABOUT THE K_{l3} AND HYPERON LEPTONIC DECAYS. Bohm, A. (Univ. of Texas, Austin). Lett. Nuovo Cim.; 11: No. 1, 13-17(7 Sep 1974).

The need for second-class contributions to explain experimental results on K_{l3} and hyperon leptonic decays is examined. The usual assumption is replaced by the assumption that the octet of vector operators and axial vector operators belong to the same octet of an SU_3-spectrum generating group. A mass relation is obtained which indicates that the existence of second-class contributions seems to be in agreement with the most recent fit to the experimental data. (LBS)

1836 EXOTIC INTERACTIONS OF CHARGED LEPTONS. Beg, M.A.B.; Feinberg, G. (The Rockefeller University, New York, New York 10021). Phys. Rev. Lett. 33: No. 10, 606-610 (2 Sept 1974).

We consider the information available about nonelectromagnetic lepton interactions in experiments which are relatively insensitive to the loop structure of the underlying theory. Further experiments which would clarify the role of exotic interactions are proposed and discussed. (auth)

1837 WEINBERG ANGLE AS A TEST OF SU(n)—TYPE UNIFIED GAUGES. Rosen, S.P. (Purdue University, West Lafayette, Indiana 47907). Phys. Rev. Lett. 33: No. 10, 614-616 (2 Sept 1974).

I consider generalizations of the Georgi—Glashow unified gauge theory to SU(n), and show that $\sin^2\theta_w = (n-2)/2(n-1)$. I also note a difficulty in extracting the value of $\sin^2\theta_w$ from neutral—current data, and suggest that the best method for doing so is the comparison of $\bar{\nu}_\mu$—e and ν_μ—e scattering provided that the ratio of the cross sections is less than 13/7. (auth)

1838 GAUGE INDEPENDENCE AND UNITARITY IN THE WEINBERG UNIFIED THEORY. Hsu, J. P.; Sudarshan, E. C. G. (Texas Univ., Austin (USA). Center for Particle Theory). Phys. Lett., B; 51: No. 4, 349-352(19 Aug 1974).

The Weinberg theory is formulated with the help of the Lagrangian multiplier formalism. A new fictitious Lagrangian is obtained which differs from the usual one. It is shown by explicit calculation that it restores unitarity and gauge independence of the theory. (auth)

1839 NEUTRAL TO CHARGED CURRENT RATIOS IN THE QUARK—PARTON MODEL. Lahanas, A. (Univ. of Durham, Eng.). Lett. Nuovo Cim.; 11: No. 6, 363-368(12 Oct 1974).

Cross sections for the reactions $\nu N \to \mu^- X$, $\bar{\nu}N \to \mu^+ N$, $\nu N \to \mu X$, $\bar{\nu}N \to \bar{\nu}X$ are calculated in the Kuti—Weisskopt quark—parton model and are examined in the deep inelastic region. The Weinberg renormalizable theory of weak and electromagnetic interactions is assumed and variations on the Kuti—Weisskopf model are considered. The first two processes are mediated by the W-boson exchange (neutral current). These currents are constructed in the model, and one can fit the existing data. (JFP)

1840 UNITARITY BOUND ON THE DECAY RATE OF $K^+ \to \pi^+ + e^+ + e^-$. Julia, B. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Lett. Nuovo Cim.; 11: No. 5, 309-314(5 Oct 1974).

The experimental upper limit on the decay rate of $K^+ \to \pi^+ + e^+ + e^-$ is considered. Since this upper limit should be much improved in the near future, it is useful to compute a theoretical lower bound on the decay rate. This lower bound on the branching ratio was found to be $3(10)^{-10}$. (JFP)

1841 A COMBINED ANALYSIS OF THE $K^+ \to \pi^0 e^+ \nu$ AND $K^+ \to \pi^0 \mu^+ \nu$ DECAY MODES. Braun, H.; Cornelissen, M.; Martyn, H. U. (Technische Hochschule Aachen (F. R. Germany). 3. Physikalisches Inst.); Erriquez, O.; Natali, S.; Romano, F. (Bari Univ. (Italy). Istituto di Fisica); Bertrand, D.; Csejthey-Barth, M.; Lemonne, J.; Renton, P. Phys. Lett., B; No. 4, 393-396(19 Aug 1974).

A model independent determination of the form factors $\xi(q^2)$ and $f(q^2)$ has been made, measuring, in intervals of q^2, the partial branching ratio $\Gamma(K^+_{\mu 3})/\Gamma(K^+_{e3})$ and using the results of the K^+_{e3} Dalitz plot density analysis. No evidence has been found for a strong deviation from a linear q^2 dependence of the form factors. Within this approximation a combined analysis of the K^+_{e3} and $K^+_{\mu 3}$ Dalitz plots gives the parameters $\lambda_0 = -0.017 \pm 0.011$ or alternatively $\xi(0) = -1.3 \pm 0.7$ and $\xi(4.4m_\pi^2) = -0.45 \pm 0.13$, with in both cases a fitted value of $\lambda_+ = 0.025 \pm 0.007$. (auth)

1842 THE DIRECT DECAY $K^+ \to \pi^+\pi^0\gamma$ AND ITS RELATION TO OTHER WEAK RADIATIVE DECAYS. Moshe, M. (Tel Aviv Univ. (Israel). Dept. of Physics); Singer, P. (Technion-Israel Inst. of Tech., Haifa. Dept. of Physics). Phys. Lett., B; 51: No. 4, 369-370(19 Aug 1974).

A model for weak nonleptonic transitions, previously shown to explain $K^0_2 \to \gamma\gamma$ and other weak radiative K-meson decays, is applied here to $K^+ \to \pi^+\pi^0\gamma$. It reproduces correctly the recently determined dominance of the magnetic transition and allows firm predictions to be made for the related $K^+ \to \pi^+\gamma\gamma$ and $K^0_2 \to \pi^+\pi^-\gamma$ transitions. (auth)

1843 REMARKS ON NEUTRAL CURRENT PHENOMENOLOGY. Llewellyn Smith, C. H.; Nanopoulos, D. V. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 78: No. 2, 205-221(25 Aug 1974).

The effects of neutral currents in various leptonic ($g-2$, $e^+e^- \to e^+e^-$, $e^+e^- \to \mu^+\mu^-$, $e^-e^- \to e^-e^-$) and semi-leptonic ($\nu N \to \nu^+ \ldots$, $\binom{e}{\mu} N \to \binom{e}{\mu}^+ \ldots$) processes are examined in a unified systematic model-independent way. Existing data are used to bound the effects in $\binom{e}{\mu} N \to \binom{e}{\mu}^+ \ldots$. The bounds turn out to be very weak so that experiments may be worth while even if they cannot approach the accuracy required to detect the effects predicted by the Weinberg—Salam model. (auth)

Strong (General)

Refer also to abstract 2314.

1844 (COO-1764-200) LEAKAGE OF QUARK CHARGE. Farrar, G. R.; Rosner, J. L. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). 1974. Contract AT(11-1)-68. 14p. Dep. NTIS $4.00.

A sequential model for the fragmentation of a quark into hadrons is constructed with the property that a charge Q "leaks" down the multiperipheral chain. Specifically, for a process initially producing a quark, $Q = (\frac{1}{2})(1-r)/(2+r)$, where r is the ratio of directly produced $K^\pm$ to $\pi^\pm$ in the quark fragmentation plateau. This expression corrects an earlier one in which the consequences of such a model were misstated. (auth)

1845 (JINR-D-6004, pp 393-439) MODELS FOR HIGH-ENERGY COLLISIONS OF HADRONS. Quigg, C. (State Univ. of New York, Stony Brook). 1972.

From international seminar on binary reactions of hadrons at high energies; Dubna, USSR (3 Jun 1971).

Following general opening remarks, three specific phenomenological problems are discussed. For two-body scattering, the questions of the role of Regge cuts and the spin structure of scattering amplitudes are considered. Comments are made on inclusive reactions and their relation to two-body channels. Throughout the paper, emphasis is placed upon the suggestion of useful experiments. (auth)

1846 (RL-74-119) DIFFRACTION AND MULTIPARTICLE UNITARITY IN THE DUAL MODEL. Chang, Hong-Mo. (Science Research Council, Chilton (UK). Rutherford Lab.). Aug 1974. 19p. Dep. NTIS (US Sales Only) $4.00.

In this lecture an approximate iterative method for constructing hadronic amplitudes in general is proposed starting from a few assumptions based on phenomenology. Some of its virtues are illustrated. By combining certain empirical observations with multiparticle unitarity, one may hope to arrive at a reasonable model of strong interactions. (JFP)

1847 (RRK-73-18) MASS FORMULA FOR HADRONS AND A NONET SCHEME FOR MESONS. Fukuda, T.; Yanagida, T.; Yonezawa, M. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Oct 1973. 17p. NTIS (US Sales Only).

The hadron mass formula is discussed in the quark-counting aspect. It is shown that the "free" quark picture gives the Gell-Mann-Okubo formula. A nonet mass formula for mesons is proposed and the inverted assignment for the $\eta(549)$ and the $\eta'(958)$ in the 0^- nonet is suggested. Classification of existing mesons into nonets is attempted. (auth)

1848 LIGHT-CONE ALGEBRA AND MATERIALIZATION OF QUARKS. Tuan, S. F. (Univ. of Hawaii, Honolulu). Contract AT(04-3)-511. Lett. Nuovo Cim.; 10: No. 18, 815-820(31 Aug 1974).

The materialization of quarks is discussed within the context of light-cone algebra. (LBS)

1849 FACTORIZATION, LOGARITHMICALLY RISING TOTAL CROSS SECTIONS, AND THE POMERON. Joshi, G. C.

(Univ. of Melbourne). Lett. Nuovo Cim.; 10: No. 18, 821-825 (31 Aug 1974).

A dipole type of l-plane singularity which gives logarithmically rising total cross section and factorization at high energies is investigated. The s-asymptotic behavior of the total scattering amplitude when such a dipole is exchanged in the t-channel is examined. The principle conclusion is that it is possible to construct a factorizable singularity in the l-plane which gives rising cross sections. (LBS)

1850 NEW MODEL OF REGGE CUT. Chia, S. P. (International Centre for Theoretical Physics, Trieste, Italy). Lett. Nuovo Cim.; 10: No. 18, 837-840(31 Aug 1974).

A model for calculating the Regge cut based on the Mandelstam diagram is outlined. It is pointed out that the model has an advantage over the absorption model in that the cut has sufficient structure even with a simple pomeron. (LBS)

1851 CORRELATIONS BETWEEN NEUTRAL AND CHARGED PIONS IN MULTIPARTICLE PRODUCTION. Arneodo, A.; Kubar-Andre, J. (Nice Univ., 06 (France). Lab. de Physique Theorique). Nucl. Phys., B; 77: No. 2, 309-336(4 Aug 1974).

A theoretical and phenomenological study is made of correlations between neutral and charged pions in multiparticle production in the framework of the so-called, σ,π,ρ and ρ-ρ models. Following the method of Drijard and Pokorski, the predictions of various models are expressed in terms of the negative multiplicity distribution, which is known experimentally. In particular the average number of π^0,$\bar{n}_0(n_-)$, and the integral of π^0-π^0 correlations, $f_0^0(n_-)$, are computed as a function of the number of negative pions; also the total multiplicity distribution P(N) and its first two moments $\bar{N}$ and D^2_{tot} are studied. It is shown that with the present experimental accuracy neither $\bar{n}_0(n_-)$ nor $f_0^0(n_-)$ allows discrimination between the different models. (auth)

1852 THE PHYSICAL CONTENT OF THE STATISTICAL BOOTSTRAP. Gorenstein, M. I.; Miransky, V. A.; Shelest, V. P.; Zinovjev, G. M. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki); Satz, H. (Bielefeld Univ. (F. R. Germany)). Nucl. Phys., B; 76: No. 3, 453-476(18 Jul 1974).

The essential results of the statistical bootstrap model are a level density linearly exponential in total energy, and an asymptotically bounded average energy per secondary. The physical basis of these results is analyzed and it is shown that they follow from much more general considerations than the assumptions of the statistical bootstrap model. A fireball, from its decay aspects, can be any hadronic system at rest (independent of its content), if it has the coordinate space volume necessary to allow a free gas description in momentum space. From the point of view of fireball composition, the essential feature leading to bootstrap behavior is the distribution of excited states according to linear Regge trajectories. Subsequently the assumptions under which the statistical bootstrap model can be derived from the dual resonance model, and in what way the inclusion of fireball formation dynamics can modify a bootstrap picture are studied. As a result, the concept of an ultimate hadronic temperature does not remain tenable as a general feature even in a dynamical theory with a linearly exponential level density. (auth)

1853 ELECTROMAGNETIC CORRECTIONS TO HADRON-HADRON SCATTERING. Tromborg, B. (Niels Bohr Institutet, Copenhagen (Denmark)); Hamilton, J. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). Nucl. Phys., B; 76: No. 3, 483-540(18 Jul 1974).

S-matrix methods are used to determine the electromagnetic corrections to relativistic hadron scattering. The infrared divergences associated with soft photon emission and with the Coulomb interaction are removed to give a finite scattering amplitude which obeys crossing and has the usual analytic structure. An approximate calculation of the electromagnetic correction to the phase of the πN P_{33} amplitude is given. (auth)

1854 HOW STRONG ARE STRONG INTERACTIONS. Fritzsch, H.; Minkowski, P. (California Inst. of Tech., Pasadena (USA)). Nucl. Phys., B; 76: No. 3, 365-374(18 Jul 1974).

It is suggested that strong interactions are described by the renormalizable, asymptotically free gauge field theory of colored quarks and gluons and that the renormalized quark-gluon coupling constant is small, when evaluated at momenta of the order of the proton mass. The true asymptotic predictions of this theory for deep inelastic scattering are shown to be irrelevant for present experiments. Scaling is found to be violated logarithmically according to lowest order perturbation theory. Upper bounds for the strong interaction coupling constant are derived. (auth)

1855 NEW FORM OF VECTOR MESON DOMINANCE AND THE DEPENDENCE ON THE VECTOR MESON MASS SQUARED. Iso, C.; Iwai, S.; Kanasugi, H. (Tokyo Inst. of Tech. (Japan). Dept. of Physics); Miyata, Y. (Tokyo Univ. of Education (Japan). Dept. of Physics). Nucl. Phys., B; 77: No. 1, 35-44(25 Jul 1974).

A new form of VMD is proposed which relates the reactions $\pi N \to VN$ and $\gamma N \to \pi N$. This form fits the experimental results within errors. As the restriction is strong enough, the k_μ^2 dependence can be discussed. Unexpectedly the k_μ^2 dependence is larger and this suggests the necessity of generalized vector dominance. (auth)

1856 DIFFRACTIVE DISSOCIATION AND THE EARLY KNO SCALING. Fialkowski, K. (Uniwersytet Jagiellonski, Krakow (Poland). Instytut Fizyki). Phys. Lett., B; 51: No. 2, 177-178 (22 Jul 1974).

The assumption of asymptotic validity of early KNO scaling combined with the existence of diffraction is shown to result in strong restrictions on the asymptotic multiplicity distributions. (auth)

1857 SHORT-TIME BEHAVIOUR OF HADRONIC INTERACTIONS AND THE HADRON-NUCLEUS PRODUCTION PROCESSES. Bialas, A. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (F. R. Germany)); Czyz, W. (Institute of Nuclear Physics, Krakow (Poland)). Phys. Lett., B; 51: No. 2, 179-183(22 Jul 1974).

A model for short-time behavior of hadronic interactions is proposed and applied to production processes in hadron-nucleus collisions. The main feature of the model, which may be considered as a generalization of the bremsstrahlung mechanism, is the explicit distinction between the interaction of the leading particles and the produced particles. The model explains: (a) the applicability of the Glauber-model formula for elastic and total cross-sections, (b) the low attenuation of the diffractively produced objects, and (c) the low multiplicities in hadron-nucleus interactions and their weak dependence on A. A conjecture is put forward that the lack of shadowing in highly inelastic electron-nucleus and neutrino-nucleus collisions is due to a similar short-time behavior as in the case of purely hadronic interactions. (auth)

1858 DUAL PERIPHERAL MODEL UP TO SERPUKHOV ENERGIES. Schrempp, B.; Schrempp, F. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 77: No. 3, 453-478(11 Aug 1974).

As developed earlier, the s-channel approach starts from a description of inelastic two-body reactions at high energies in terms of one single complex peripheral Regge trajectory in the s (and μ) channel. In this paper the high energy behavior of the corresponding s-channel Regge residues is inferred from three plausible requirements. The resulting s-channel helicity amplitudes allow – in a dual sense – the following t-channel interpretation: for $-t \geq 0.25$ GeV^2 the flip amplitude has the form of a t-channel Regge pole, while the non-slip amplitude looks like a Regge cut. Finally, a quantitative comparison of the predictions with the data available for the set of SU(3) related processes πN CEX, KN, $\bar{K}N$ CEX and $\pi^- p \to \eta n$ is performed, covering the energy range $2 \leq p_{lab} \leq 48$ GeV/c (Serpukhov energies) and the range of momentum transfer $0.25 \leq -t \leq 2-4$ GeV^2. Considering the small number of only four free parameters, the s-channel approach appears to be in good agreement with these data. In particular the line reversal breaking in KN, KN CEX finds a natural explanation. (auth)

1859 PARTON DISTRIBUTIONS IN HADRONS AND THE CROSS SECTIONS FOR LEPTON PAIR PRODUCTION. Farrar, G. R. (California Inst. of Tech., Pasadena (USA)). Nucl. Phys., B; 77: No. 3, 429-442(11 Aug 1974).

A number of constraints, several new, are exploited to obtain realistic quark parton distributions for baryons and mesons. These distributions are used to make detailed predictions for NN or $\pi N \to l^+l^-$ + anything, potentially providing a quantitative test of the quark parton model. Differential cross sections for a single lepton observed in the final state are also given. (auth)

1860 LARGE TRANSVERSE MOMENTA IN THE THERMODYNAMICAL MODEL. Bouquet, A.; Letessier, J.; Tounsi, A. (Lab. de Physique Theorique et Hautes Energies, Paris, France). Phys. Lett., B; 51: No. 3, 235-238(5 Aug 1974).

The transverse momentum dependence of inclusive cross sections at high energies is one of the main results of ISR experiments. It led to many theoretical analyses involving the physical nature of hadrons, mainly using the parton hypothesis. However, as is shown in this letter, other interpretations are possible. It is pointed out that the thermodynamical model give a good description of large transverse momenta phenomena as a natural consequence of the linear structure of the cluster decay chains. (auth)

1861 UNIFIED DUAL MODEL FOR INTERACTING OPEN AND CLOSED STRINGS. Ademollo, M. (Istituto Nazionale di Fisica Nucleare, Florence (Italy)); D'Adda, A.; D'Auria, R.; Napolitano, E. (Turin Univ. (Italy). Istituto di Fisica); Di Vecchia, P.; Gliozzi, F.; Sciuto, S. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 77: No. 2, 189-225(4 Aug 1974).

The vertices which describe the emission of closed string particles (pomerons) out of open string states (reggeons) are constructed. Using those vertices a ghost-free unified dual model can be constructed for the amplitude of an arbitrary number of reggeons and pomerons which contains both the conventional Veneziano model and the Shapiro-Virasoro model. The factorization properties of this model are studied in detail. In particular, the reggeon-pomeron direct coupling is extracted from the channels where both reggeons and pomerons can be exchanged. (auth)

1862 RIGOROUS SPIN TESTS FROM TWO-AMPLITUDE STRONG DECAYS. Daumens, M.; Massas, G.; Minnaert, P. (Bordeaux-1 Univ., 33-Gradignan (France). Lab. de Physique Theorique). Nucl. Phys., B; 77: No. 2, 360-364(4 Aug 1974).

The rigorous spin tests given by Doncel, Michel and Minnaert for the usual one-amplitude strong decays ($j \to 1\ 0$, $j \to 2\ 0$, $j \to \frac{1}{2}\ 0$.) (auth)

1863 BREMSSTRAHLUNG MODEL FOR HADRON PRODUCTION AT LARGE TRANSVERSE MOMENTA. Contogouris, A. P.; Holden, J. P. (McGill Univ., Montreal, Quebec (Canada). Dept. of Physics); Argyres, E. N. (State Univ. Coll., Plattsburgh, N. Y. (USA)). Phys. Lett., B; 51: No. 3, 251-256(5 Aug 1974).

A hadronic bremsstrahlung model is presented which provides an understanding of several of the recently observed phenomena at large transverse momenta. The general picture is that hadronic processes at small P_T are governed by multiperipheral mechanisms (plus some small diffraction component); these are responsible for exponential fall-offs and the other features of the small p_T inclusive data; they also reproduce a mean multiplicity which varies little, if at all, with p_T. At small p_T bremsstrahlung is unimportant; however, as p_T increases beyond 1 GeV it becomes the dominant physical process. (auth)

1864 CONSEQUENCES OF A DUAL RESONANCE EXCLUSIVE KERNEL FOR HADRONIC CORRELATIONS. Manesis, E. K. (Ioannina Univ. (Greece)). Phys. Lett., B; 51: No. 3, 259-262 (5 Aug 1974).

The exclusive kernel of a previously proposed integral equation (IE) is expressed in terms of DRM amplitudes in the central region. The $|B_2/B_1|$ relative normalization is fitted to four-prong NAL data. The IE is then solved numerically to compute the inclusive correlated density $R_{cc}(y)$. It is also predicted that R_{+-}: R_{++}: $R_{--} = f_c : \rho_+ : \rho_-$, $f \sim 2$, at $y = 0$. (auth)

1865 COMBINING AND SPLITTING RELATIVISTIC STRINGS. Cremmer, E.; Gervais, J.L. (Paris-11 Univ., 91-Orsay (France). Lab. de Physique Theorique et Hautes Energies). Nucl. Phys., B; 76: No. 2, 209-230(11 Jul 1974).

A detailed study of the dual vertex is presented. Starting from the overlap conditions, a three-string vertex is given in the basis where the string operator is diagonal, which describes how the initial and final states are related at the time of interaction. This vertex is then expressed in terms of the annihilation operators by changing to the coherent state basis, or by allowing each string to propagate for a very long time. This form of the vertex is then shown to be identical to the vertex of Ademollo et al. and Mandelstam, thus proving that it is the correct three-reggeon vertex of the Veneziano model. (auth)

1866 CONNECTION BETWEEN THE PHOTON CONSTITUENT AND NEUMAN-FUNCTION FORMS OF THE DUAL VERTEX. Fenster, S. (Argonne National Lab., IL). Lett. Nuovo Cim.; 11: No. 1, 9-12(7 Sep 1974).

Two alternative derivations for the vertex of three excited physical particles have been constructed—one by means of a photon operator, obtaining a D-function, and the other based on a derivation on the Neumann function, but computed in the string domain of the complex plane. A direct way is found to compute the Neumann function in the form of the D-function by introducing Cauchy's theorem for two complex variables. (LBS)

1867 PHYSICAL BASES FOR A NEW THEORY OF MOTION. Allen, A. D. (Algorithms, Inc., Northridge, CA). Found. Phys.; 4: No. 3, 407-412(Sep 1974).

It was recently shown that a mathematical question regarding the fundamental constituents of hadrons cannot be resolved unless the classical axioms of nonfinite mathematics are revised in such a way as to produce a new theory of particle motion in continuous space-time. Under this new theory, the instantaneous position of a moving object has a magnitude that is increasing as the object's velocity. The purpose is to show that, quite apart from the question of Cantorian axiomatics, the new theory of motion is more consistent with what physicists really believe than the traditional theory of motion. (auth)

1868 SCATTERING FORMALISM FOR INTERACTING MULTIPARTICLE SUBSYSTEMS. Lukierski, J. (Trier-Kaiserslautern Univ., Kaiserslautern, Ger.). Nuovo Cim., 23A: No. 4, 716-732(21 Oct 1974).

The scattering formalism for the multiparticle systems interacting before and after scattering—in particular for unstable particles, resonances and clusters—is outlined. The main formal tool proposed is an auxiliary pre-asymptotic space $\mathcal{H} = \mathcal{H}_{in} = \mathcal{H}_{out}$ describing the self-interacting "ingoing" and "outgoing" multiparticle states. The characteristic features of the states in $\mathcal{H}$—continuous mass spectra and virtual propagation—are briefly discussed. It is shown further that the physical unitarity condition is satisfied and double counting avoided if in the auxiliary space $\mathcal{H}$ the phase space is properly defined. (auth)

1869 MOMENTUM-DEPENDENT TRANSFORMATION BETWEEN BARE AND CONSTITUENT QUARKS. Kobayashi, T. (Tokyo Univ. of Education). Lett. Nuovo Cim.; 11: No. 6, 345-351(12 Oct 1974).

It is shown that a previously proposed model for the relativistic quark model, in which it is expected that the symmetry of the spin-unitary part changes as the unitary spin wave functions of hadrons change as the momentum increases, is equivalent to the model in which a momentum-dependent potential is introduced. Some applications are given for the form factors G_A/G_V and F/D are discussed. (JFP)

1870 TWO-BODY PROBLEM IN THE ADIABATIC AND STRONG COUPLING. Solodovnikova, E. P.; Tavkhelidze, A. N. Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 21: No. 1, 13-29(Oct 1974). (In Russian).

Two-body problem for the case of the nonweak interaction is considered. N. N. Bogoliubov's transformation is extended to the case of two bodies in such a way that the center of mass motion could be singled out and relative motion of particles could be described. (auth)

1871 A "THREE-COMPONENT" MODEL FOR HADRON TOTAL CROSS SECTIONS. Lipkin, H. J. (Weizmann Inst. of Science, Rehovoth (Israel)). Nucl. Phys., B; 78: No. 3, 381-395 (4 Sep 1974).

Relations between hadron-nucleon total cross sections are obtained from a model containing a new third component in addition to the naive two-component description with a pomeron coupled to pions, kaons and nucleons in the ratio 1:1:3/2, and an annihilation component given by counting duality diagrams. Third component contributions are calculated by a quark-counting recipe motivated by double-scattering corrections. This recipe relates the discrepancies between pomeron contributions of the simple two-component model and allows separation of f and pomeron contributions in order to test symmetry and universality relations involving the f contribution. All relations agree with experiment to within a few percent. (auth)

1872 A PHENOMENOLOGICAL MODEL FOR A LOCAL REGGE POLE-REGGE CUT INTERACTION. Ghandour, G. I. (California Univ., Berkeley (USA). Dept. of Physics). Nucl. Phys., B; 79: No. 3, 461-483(25 Sep 1974).

In the context of the multiperipheral model, an effective-range approximation and the formula for the discontinuity of the partial-wave amplitude across the AFS cut is used to construct a model amplitude that incorporates the reggeon-pomeron cut in addition to the simple Regge pole. This amplitude is used in an attempt to explain the structure of the high-energy differential cross section at small t, as observed at ISR. This model explains in addition the discrepancy between the values for the rho-intercept obtained from the differential cross section on the one hand and the difference of π^+p total cross sections, at high energy, on the other. The absence of such a discrepancy in the case of the omega trajectory can also be understood. (auth)

1873 HOW DO CLUSTERS LOOK IN SEMI-INCLUSIVE CROSS SECTIONS. Morel, A. (European Organization for Nuclear Research, Geneva (Switzerland)); Plaut, G. (Nice Univ., 06 (France)). Nucl. Phys., B; 78: No. 3, 541-551(4 Sep 1974).

It is shown how semi-inclusive quantities can be used in order to learn something about the decay of clusters in independent cluster

emission models. The average multiplicity, and binomial moments, to the cluster decay distribution are proved to increase with the total multiplicity. The rate of increase can be looked at through semi-inclusive correlation measurements, and is shown to contain interesting information about the clusters. (auth)

1874 QUARKS AND REGGEONS. Kleinert, H. (California Inst. of Tech., Pasadena (USA)). Nucl. Phys., B; 79: No. 3, 526-545(25 Sep 1974).

A new algebra is proposed which will hopefully contribute to the joint understanding of electromagnetic and weak structure functions and of Regge couplings. It involves an infinite number of form factors of arbitrary complex spin J (with Re(J-1) > 0) and definite signature. The algebra holds exactly in a quark-gluon model when quantized canonically on equal light fronts. If all form factors have k = 0 and J = 1, the algebra closes and becomes U(6) × U(6), with the connecting subgroups being associated with pure quarks and pure antiquark currents, respectively. This doubling of the group leads to exact exchange degeneracy if baryon and mesons consist of qqq and $q\bar{q}$ wave functions only. To some lowest approximation, Regge couplings can be calculated by representing U(6) × U(6) on properly mixed quark wave functions. With the mixing parameters fixed by the chiral subgroup, these couplings are determined up to an overall normalization. As an illustration, the couplings of the trajectories ρ, ω; A_2, f; A_1, D; Z_1, Z_{88}; π, η; B, H trajectories are estimated for the meson resonances ρ, ω; π, η; A_2, f; A_1, D; B, H; A_0, σ. The trajectories π, η; B, H are not in the algebra initially but can be inferred from an extension of PCAC to the bilocal currents (PCBC). (auth)

1875 LONGITUDINAL MOMENTUM TRANSFERS IN THE MULTIPERIPHERAL MODEL. Henyey, F. S. (Michigan Univ., Ann Arbor (USA). Dept. of Physics). Nucl Phys., B; 78: No. 3, 435-444(4 Sep 1974).

The inclusion of longitudinal momentum transfers in the multiperipheral model is investigated. As recently pointed out by Jadach and Turnau, these longitudinal momentum transfers, if present, have a very large effect on properties of the model. In this paper it is found that data rules out such effects. Furthermore, if the longitudinal momentum effects were present, they would in no way solve the serious problem with the multiperipheral model, that average multiplicity and elastic slope ought to be proportional, but experimentally are not. A multiperipheral model using transverse momentum transfers has fewer phenomenological difficulties than one using total momentum transfer. (auth)

1876 LONGITUDINAL GEOMETRY IN INCLUSIVE SPECTRA AND MULTIPLICITY SCALING. Buras, A. J.; Dias de Deus, J. (Niels Bohr Institutet, Copenhagen (Denmark)). Nucl. Phys., B; 78: No. 3, 445-454(4 Sep 1974).

A geometric picture of inclusive distributions in hadron-hadron high-energy collisions is proposed, in which all inclusive quantities depend on the incoming energy only through variables $\xi_i = y_i/Y$, where y_i are rapidities of produced particles and Y is essentially the available rapidity. This picture seems to have support from both inclusive spectra and multiplicity distributions at high energy. The approach is discussed in connection with two-component and cluster models. (auth)

1877 ELECTRON-POSITRON ANNIHILATION AND SPECULATIONS ON THE RENORMALIZATION GROUP OF STRONG INTERACTIONS. Kogut, J. (Cornell Univ., Ithaca, N. Y. (USA). Lab. of Nuclear Studies). Phys. Lett., B; 51: No. 4, 383-386 (19 Aug 1974).

Implications of recent measurements of the electron-positron annihilation cross section for other deep inelastic processes are discussed within the context of conventional field theory and conventional current algebra. Canonical scaling laws for deep inelastic electron and neutrino scattering are predicted to fail for $Q^2 \gtrsim 15-25$ GeV^2. Other easily measured consequences of a violation of scale invariance at short distances are discussed. Comments and speculations concerning the renormalization group of strong interactions are made. (auth)

1878 MODEL FOR INCLUSIVE PRODUCTION OF PROTONS, ANTI-PROTONS, PIONS AND KAONS WITH LARGE TRANSVERSE MOMENTA. Chavda, L. K. (Indian Inst. of Tech., Bombay); Narayan, D. S. (Tata Inst. of Fundamental Research, Bombay (India)). Phys. Lett., B; 51: No. 4, 359-364(19 Aug 1974).

The production of particles with large transverse momenta P_T and other unexpected features observed with CERN ISR are explained on the basis of a model which traces their origin to a small class of events, called central collisions, involving "core-core" interactions. In each central collision, two massive fire balls, moving slowly in the C.M. system, are produced and they decay according to Fermi's statistical theory. The model makes specific predictions like correlations between large P_T, high multiplicities and production of antiprotons. (auth)

1879 SELF-CONSISTENT DIFFRACTION IN THE MULTIPERIPHERAL MODEL III. Ball, J. S. (Utah Univ., Salt Lake City (USA)); Zachariasen, F. (California Inst. of Tech., Pasadena (USA)). Nucl. Phys., B; 78: No. 1, 77-92(18 Aug 1974).

A previously suggested model for high-energy diffraction scattering is explored further, with the goal of obtaining lower energy corrections to the asymptotically self-consistent amplitude which can allow a comparison with existing experimental data. Implications of the model for one-particle inclusive distributions are also described. Finally, a number of theoretical comments, having to do with absorptive corrections, with t-channel unitarity, with decoupling, and with factorization, are made as well. (auth)

1880 HIGH ENERGY BOUNDS FROM UNITARITY SUM RULES. Haan, O.; Muetter, K. H.; Stamatescu, I. O. (Heidelberg Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Nucl. Phys., B; 78: No. 3, 493-514(4 Sep 1974).

Unitarity sum rules are evaluated by means of one-particle exchange (OPE) approximation for the missing-mass discontinuities. The existence of non-vanishing "pole dominance regions" where the OPE approximation is applicable, is sufficient to derive limitations on coupling constants and particle production amplitudes. In particular, from one-pion exchange it is found that the ratios of elastic and total cross sections are bounded $\sigma_{el}(s)/\sigma_{tot}(s) < 0$ (1/logs), for $s \to \infty$, in $\pi\pi$ and πN scattering. In a theory with scalar bosons, the high-energy behavior of the absorptive part of the four-point function gets a lower bound in terms of the trilinear coupling constant. (auth)

1881 AVERAGE TRANSVERSE MOMENTA IN SEMI-INCLUSIVE PROCESSES. Farkas, I.; Montvay, I. (Eotvos Lorand Tudomanyegyetem, Budapest (Hungary)); Jenik, L.; Krasznovszky, S. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). Nucl. Phys., B; 78: No. 3, 468-483(4 Sep 1974).

The average transverse momenta in semi-inclusive processes and associated semi-inclusive distributions are investigated as a function of the prong number. The predictions of the statistical chain model of hadron clusters are compared with 40 GeV/c π^-p data and good agreement is found. (auth)

1882 CURRENT ALGEBRA AND HADRON CLASSIFICATION. Vong Dyc, D.; Van Hieu, N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). Nucl. Phys., B; 78: No. 3, 403-412(4 Sep 1974).

The realization of irreducible representations of the SU(6) × SU(6) current algebra in the linear spaces of asymptotic creation and annihilation operators of particles at rest is studied. This approach is free of difficulties encountered when realizing this algebra in the Hilbert space of state vectors. A possibility of the classification of hadrons according to the irreducible representations of this algebra is considered. (auth)

1883 TEST OF THE VECTOR DOMINANCE MODEL BY FORWARD AND BACKWARD ρ^0 AND ω^0 PRODUCTION. Charlesworth, J. A.; Sekulin, R. L. (Science Research Council, Chilton (UK). Rutherford Lab.); Emms, M. J.; Kinson, J. B.; Stacey, B. J.; Votruba, M. F.; Woodworth, P. L. (Birmingham Univ. (UK)); Bell, I. G.; Dale, M.; Evans, D. Nucl. Phys., B; 79: No. 3, 375-380(25 Sep 1974).

New data on $\pi^+n \to \rho^0p$ and $\pi^+n \to \omega^0p$ at 4 GeV/c are compared with single-pion photoproduction data. Good agreement is obtained with the predictions of the vector dominance model from unpolarized photoproduction data. However, in the forward direction, the proportion of natural parity exchange observed in vector meson production is much smaller than that predicted by the VDM from polarized photoproduction data. (auth)

Strong (Baryon No. = 0)

1884 (RRK-74-4) π_8^0-η_1 MIXING. Fukuda, Ta.; Kawasaki, M.; Yanagida, T.; Yonezawa, M. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Apr 1974. 17p. NTIS (US Sales Only).

Enhanced π_8^0-η_1 mixing is suggested from the nonet mass formula $\eta_8 - \eta_1 \simeq \eta_1 - \pi_8^0$ with the assignment $\eta_1 \simeq \eta(549)$ and $\eta_8 \simeq \eta'(958)$. The estimated linear mixing angle is $|\theta| \simeq 0.07$ rad. Effects of π_8^0-η_1 mixing on the pion-nucleon coupling constant, the $K \to \pi\pi$ decay and the $\eta \to \pi\pi\pi$ process are briefly discussed. (auth)

1885 MESONS IN TERMS OF QUARKS ON A NULL PLANE. Leutwyler, H. (Bern Univ. (Switzerland). Inst. fuer Theoretische Physik). Nucl. Phys., B; 76: No. 3, 413-444(18 Jul 1974).

The notion of quark wave functions on a null plane is used to give an unambiguous meaning to some of the concepts used in the parton model. Sum rules are derived for the meson quark wave functions on the basis of the assumption that the divergences of vector and axial currents are proportional to quark mass terms. Using a simple model for the relation between current and constituent quarks a set of symmetry relations among the wave functions of the lowest lying U(6) multiplet of mesons is obtained. These relations lead to a formula for the non-strange quark mass, $m_\mu = m_\pi^2 F_\pi / 3 m_\rho F_\rho = 5.4$ MeV. The strange quark mass is constrained to lie between 125 and 150 MeV. (auth)

1886 A PHENOMENOLOGICAL INVESTIGATION OF $\pi\pi \to K\bar{K}$ PARTIAL-WAVE AMPLITUDES FROM HYPERBOLIC DISPERSION RELATIONS. Hedegaard-Jensen, N. (Aarhus Univ. (Denmark)). Nucl. Phys., B; 77: No. 1, 173-188(25 Jul 1974).

The $\pi\pi \to K\bar{K}$ partial-wave amplitude $g_J^{(s)}$, J = 0, 1, 2, 3, is calculated in the unphysical region below the $K\bar{K}$ threshold using partial-wave relations derived from hyperbolic dispersion relations. For $g_J^{(-)}$ the results are in agreement with earlier calculations and the current low-energy predictions are confirmed. For $g_J^{(+)}$ a down-type solution with a large positive $K\bar{K} \to K\bar{K}$ s-wave scattering length is favored. (auth)

1887 EXOTIC SIGMA COMMUTATORS. Brehm, J. J. (Massachusetts Univ., Amherst (USA)). Nucl. Phys., B; 77: No. 3, 397-412(11 Aug 1974).

The author wishes to identify σ commutators, $\sigma^{\alpha\beta} = [Q_\alpha^\beta, [Q_\alpha^\beta, \mathcal{H}']]$ (α, β = 1 to 8), sufficient in number to couple to the s-wave scattering among all pairs of pseudoscalar mesons. Exotic σ commutators occur, corresponding to the exotic configurations $\pi\pi$ (T = 2), Kπ(T = 3/2) and KK(T = 1). To obtain these the symmetry breaking Hamiltonian $\mathcal{H}'$ must be constructed from operators additional to those of the (3,3) + (3,3) model. Supplementary symmetry breaking of (8,8) form is used and all the σ commutators are constructed and listed according to the pseudoscalar meson pairs to which they are coupled. The SU (2) × SU(2) properties of the operators $\partial_\mu A_\mu^a$ and σ^{ab} (a,b = 1 to 3) which couple to pions are considered and the (8,8) piece of $\mathcal{H}'$ is constrained so that these operators are dominantly (1/2,1/2) and have only a (1,1) impurity. Given this constraint on the pion-related operators, $\sigma^{\alpha\beta}$ becomes decoupled from KK s-wave scattering. The resulting $\mathcal{H}'$ then accommodates exotic s-wave phase shifts for $\pi\pi$(T = 2) and Kπ(T = 3/2) which are more weakly coupled to $\sigma^{\alpha\beta}$ than are their non-exotic counterparts, and predicts KK(T = 1) to be the weakest scattering of all to use as a probe of exotic σ commutator phenomena. (auth)

1888 RELATIVISTIC COMPOSITE MODEL CONSISTENT WITH THE BETHE–SALPETER EQUATION, APPROXIMATE SU(6) SYMMETRY AND DUALITY. I. Machida, S. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 51: No. 4, 1159-1171(Apr 1974).

A dual composite theory of many-meson amplitudes is applied to investigation of the Bethe–Salpeter (BS) equation for one-meson states. The interaction kernel is the direct extension to this case of those which were determined by duality for many-meson amplitudes. The BS equation is shown to have solutions with the following properties: there are no second-kind exotic states in the leading Regge trajectories. Mesons form approximate irreducible representations of SU(6) ⊗ $O(3)_L$ and SU(6)$_W$ ⊗ $O(2)_{L_z}$ symmetry at rest and for linearly moving states respectively. These states may be made exact irreducible representations if one takes an appropriate form of an arbitrary function of total momentum which remains in the BS amplitudes. Mesons form linearly rising Regge trajectories with respect to the total orbital angular momentum of urbaryons inside the meson. Dependence on relative space-time coordinates of the BS amplitudes is given by the factorized residue functions at the poles of the dual function in the interaction kernel. BS amplitudes on the leading trajectory have a positive norm, whereas there appear negative norm states also on the daughter trajectories when the Veneziano function is chosen as the space-time part of the interaction kernel. A discussion is given on the relations among the constructive and interactive forces and on the duality in the composite theory of hadrons. (auth)

1889 BARYON-ANTIBARYON THRESHOLD RESONANCES. Chew, G. F.; Koplik, J. (California Univ., Berkeley (USA). Dept. of Physics). Nucl. Phys., B; 79: No. 3, 365-374(25 Sep 1974).

Experimental and theoretical arguments are presented to support the conjecture of a high density of levels (resonances), with quantum numbers shared by baryon-antibaryon channels, in the neighborhood of the thresholds for such channels. These levels, generated by long-range pion exchange, are of a nature familiar in classical nuclear physics but usually ignored in particle physics. Their possible relevance to a variety of high energy phenomena is discussed, including the rising tendency of high energy hadronic total cross sections and the anomalously large e^+e^- annihilation. (auth)

1890 A RELATIVISTIC MODEL OF THE COMPOSITE π MESON. Filippov, A. T. (Joint Inst. for Nuclear Research, Dubna (USSR)). Phys. Lett., B; 51: No. 4, 379-382(19 Aug 1974).

The pion is treated as a fermion-antifermion composite state, described by the Euclidean Bethe-Salpeter equation. The kernel of the equation is a local potential having an exponentially infinite spectral function, connected with the empirical mass spectrum of resonances. For the simplest potential $U(r) = f^2(r^2 - a^2)^{-1}$ the equation for the massless pion is solved by using WKBJ method, and the parameters f,a and the fermion mass M are estimated. (auth)

1891 SYMMETRIC STRONG VERTEX IN THE RELATIVISTIC EXTENDED QUARK MODEL. Kobayashi, T. (Tokyo Univ. of Education); Nakazawa, T. Lett. Nuovo Cim.; 11: No. 6, 352-357(12 Oct 1974).

It is shown that the decay widths of mesons are consistently evaluated and that the analytic property of decay matrices is improved. A simple example for the symmetric strong vertices is presented. The decay widths for M^* and ρ^+, R_1^+ and T^+ are studied. (JFP)

1892 EXACT INTEGRAL POSITIVITY AND CROSSING CONSTRAINTS ON S AND P WAVE PION-PION SCATTERING AMPLITUDES. Piguet, O.; Wanders, G. (Lausanne Univ. (Switzerland)). Nucl. Phys., B; 78: No. 2, 313-332(25 Aug 1974).

S- and P-wave pion-pion scattering amplitudes are constrained by the fact that they have to be compatible with crossing symmetry and the positivity of the absorptive parts of all partial waves. The construction of the necessary and sufficient conditions ensuring the compatibility with positivity and an arbitrary finite set of Balachandran-Nuyts crossing conditions is described. Two sets of constraints are derived explicitly. The first set contains inequalities involving integrals of the S-waves over the unphysical interval $0 \le s \le 4m_\pi^2$. The inequalities of the second set relate integrals of S-waves over the unphysical interval to integrals of S- and P-wave absorptive parts extended to the physical region. (auth)

1893 A TEST OF FACTORISATION PREDICTIONS FOR THE FRAGMENTATION PROCESSES $\bar{p}p \to \pi^\pm$ AT $\bar{p}$ MOMENTA OF 9.1 AND 4.6 GeV/c. Gregory, P.; Everett, D.; Grossmann, P.; Mason, P.; Muirhead, H.; Warren, G. (Liverpool Univ. (UK)); Carlsson, R.; Ekspong, G.; Holmgren, S. O.; Nilsson, S. Nucl. Phys., B; 78: No. 2, 222-232(25 Aug 1974).

Relations have been derived between the invariant cross sections for various inclusive processes by assuming factorization of the leading (pomeron) and non-leading (meson) trajectories. In this paper predictions for the invariant cross sections $f(\bar{p}p \to \pi^\pm) \equiv (2E^*/\pi\sqrt{s})d^2\sigma/dx\,dp_T^2$ have been tested using data from $\bar{p}p$ interactions at 4.6 and 9.1 GeV/c. A large discrepancy between experiment and theory is apparent for the π^- data; in the π^+ case the discrepancy is less marked but still present. (auth)

Strong (Baryon No. = 1)

Refer also to abstracts 1761, 1766, and 2007.

1894 (KHFTI-73-21) MULTIPOLE (KINEMATIC) ANALYSIS OF THE $\pi N \to \pi\Delta$ REACTION. Zayats, A. A. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1973. 9p. (In Russian). INIS.

For the process $\pi N \to \pi\Delta$ (1238), the relation between the different sets of amplitudes were obtained: invariant, spiral, and scalar. The location of the scalar amplitude with respect to the multipolar amplitudes was obtained with this technique. (tr-auth)

1895 (LBL-63) πN TWO-BODY SCATTERING DATA. I. A User's Guide to the Lovelace–Almehed Data Tape. Lovelace, C.; Almehed, S.; Uchiyama, F.; Kelly, R.; Henri, V. (Rutgers–the State Univ., New Brunswick, N. J. (USA); European Organization for Nuclear Research, Geneva (Switzerland); California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1973. 139p. Dep. NTIS $10.00.

Approximately 25,000 πN elastic and charge-exchange data compiled on the Lovelace–Almehed data tape are displayed graphically. The cutoff data of this compilation effort is September 1972. (auth)

1896 (TKP-8/73) COLLECTION OF PION–NUCLEON SCATTERING FORMULAS. P. I. Actor, A.; Hoehler, G. (Karlsruhe Univ. (TH) (F. R. Germany). Lehrstuhl fuer Theoretische Kernphysik). Mar 1973. 20p.

This collection of pion–nucleon scattering formulas contains: units, kinematics, scattering amplitudes, partial amplitudes, cross sections, and polarization parameters. No derivatives and references are given. (GE)

1897 BREAKING SCALE SYMMETRY AND THE PION–NUCLEON SIGMA TERM. Becherrawy, T.; Hakim, S. J. (International Centre for Theoretical Physics, Trieste, Italy). Lett. Nuovo Cim.; 10: No. 18, 855-860(31 Aug 1974).

The connection between scale invariance as an approximate dynamical symmetry of strong interactions and the magnitude of the meson-baryon sigma-term is examined. The connected matrix elements between baryon states are examined. A baryon mass spectrum is obtained which agrees well with experiment. From the calculated mass spectrum a value $\partial_{\pi n} = (98 \pm 7)$ MeV is obtained. (LBS)

1898 AMPLITUDE ANALYSIS OF A_2 EXCHANGE AT 6 GeV/c. Girardi, G.; Godreche, C.; Navelet, H. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Service de Physique Theorique). Nucl. Phys., B; 76: No. 3, 541-548(18 Jul 1974).

An analysis of experimental data on $\pi^- p \to \eta n$ and $K^- p \to \overline{K^0} n$ reactions is performed, which enables the A_2 amplitudes to be exhibited. There is strong evidence that the A_2 spin-flip amplitude behaves like a Regge amplitude, exchange degenerate with ρ spin-flip one. (auth)

1899 A TWO COMPONENT MODEL OF TWO BODY NUCLEON DIFFRACTION DISSOCIATION AND COMPARISON WITH πp INTERACTIONS AT 3.9 GeV/c. Berlad, G.; Haber, B.; Hodous, M. F.; Hulsizer, R. I.; Kistiakowsky, V.; Levy, A.; Pless, I. A.; Singer, R. A.; Wolfson, J.; Yamamoto, R. K. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Nuclear Science). Phys. Lett., B; 51: No. 2, 187-192(22 Jul 1974).

$\pi^+ p$ reactions have been studied at 3.9 GeV/c. This paper presents some of the results of a cross channel analysis of the $\pi(N\pi)$ final state, the measurements for the diffraction dissociation channels of the individual cross sections and the s and t-channel helicity distributions. A two component model is proposed, the predictions of which are in good agreement with the data. (auth)

1900 EVEN WAVE HARMONIC OSCILLATOR MECHANISM FOR THE BARYON SPECTRUM. Mitra, A. N. (International Centre for Theoretical Physics, Trieste (Italy)). Phys. Lett., B; 51: No. 2, 149-152(22 Jul 1974).

A new mechanism is proposed for the 70 spectrum based on harmonic oscillator Q-Q potentials only in even partial waves, to keep out the 20 states. It leaves the 56 spectrum unchanges, but produces a dual spectrum for the 70, with a "half-space" rule compared with 56 and a low-lying $(70, 0^+)$. Experimental successes include a natural understanding of i) the Roper and allied states, ii) mass groupings of $L^P = 1^-$ states, and iii) low-lying radial excitations like P'_{11} (17 50). Extra predictions are discussed. (auth)

1901 PHASES OF RESONANT AMPLITUDES: $\pi N \to \rho N$. Faiman, D. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Physics). Nucl. Phys., B; 77: No. 3, 443-452(11 Aug 1974).

Using $SU(6)_W$ symmetry in its 1-broken form it is found that the newly reported relative signs of $\pi N \to \rho N$ resonant amplitudes seem to indicate a universal "$SU(6)_W$-like" preference for all observed multiplets. Since the corresponding $\pi N \to \pi\Delta$ phases favor an "$\overline{3}U\ (6)_W$" solution for the 70, $L^P = 1^-$ multiplet the 1-broken $SU(6)_W$ model now faces a serious contradiction. (auth)

1902 A DETERMINATION OF $K^+ p$ SCATTERING AMPLITUDES AT FIXED MOMENTUM TRANSFER. Pietarinen, E. (Karlsruhe Univ. (TH) (F. R. Germany). Inst. fuer Theoretische Kernphysik). Nucl. Phys., B; 76: No. 2, 231-252(11 Jul 1974).

$K^+ p$ elastic scattering amplitudes have been determined from experimental data in the range $0 \geq t \geq -1$ $(GeV/c)^2$. The amplitudes have correct analyticity and crossing properties at each fixed t value and they are approximately consistent with the elastic unitarity condition in the $K^+ p$ channel. The experimental input in the analysis consists of the $K^+ p$ elastic differential cross section and polarization measurements in the whole measured energy range. The imaginary parts of the amplitudes for $p_{lab} < 0.43$ GeV/c in the $K^- p$ low energy and unphysical region have been taken from the coupled-channel K-matrix analyses. Low energy $K^+ p$ phase-shift analyses have been used as an additional input and constraint. Uniqueness of the amplitude determination has been considered. (auth)

1903 PION–NUCLEON FORM FACTOR IN THE CHEW–LOW THEORY. Dover, C.B. (Brookhaven National Laboratory, Upton, New York 11973); Ernst, D.J.; Friedenberg, R.A.; Thaler, R.M. Phys. Rev. Lett. 33: No. 12, 728-731 (16 Sept 1974).

We suggest a form of the off–shell pion–nucleon amplitude which is motivated by simple field–theoretic considerations. This amplitude contains a momentum–dependent form factor v(k) which we determine by solving an inverse scattering problem, using the experimental phase shifts and inelasticities as input. (auth)

1904 DUAL MODEL FOR MESON–BARYON SCATTERING BASED ON CROSSING INVARIANCE. Igi, K. (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 51: No. 4, 1145-1151(Apr 1974).

A simple SU(3)-symmetric dual model for meson-baryon scattering is constructed based on the crossing invariance. If the πN-coupling constant and the (3,3) resonance width are given, supplemented by the SU(6) value of Reggeon F/D ratio for the B amplitude, this model includes no free parameters. Predictions are in fair agreement with experiments. (auth)

1905 CHIRAL SYMMETRY BREAKING AND KN SIGMA COMMUTATOR. Roy, S. R. (Jadavpur Univ., Calcutta); Roychoudhury, R. K. Pramana; 3: No. 1, 56-60(Jul 1974).

KN sigma commutator was calculated in the framework of the $(6,\bar{6}) + (\bar{6},6)$ model. It is found that though this model could not be discarded in favor of the $(3,\bar{3}) + (\bar{3},3)$ or (8,8) model, a very large value for KN sigma term is required to get a positive value of πN sigma term. (auth)

1906 UNSTABLE PARTICLE STATES AND THE S MATRIX. Loncoski, R. S. University Park, PA; Pennsylvania State Univ. (1973). 153p. University Microfilms Order No. 74-20,942.

Thesis (Ph. D.).

The hyperplane formalism for relativistic quantum theory is utilized, along with the dynamical spin content of the Pauli–Lubanski operator, to form a helicity basis for the study of the contribution to the T matrix element of states representing a single unstable particle, when these states are part of a complete set of intermediate states for a scattering process. The results for a formation process in the elastic channel, with the scattering of two spin O, stable, elementary particles and a single unstable particle with sharp dynamical spin O, are considered. The instability of the particle is rigorously included, and the modification of the results by the existence of a non-sharp dynamical spin spectrum is discussed. (Diss. Abstr. Int., B)

1907 STRANGE-MESON EXCHANGES IN ETA AND ETA-PRIME PRODUCTION. Shiga, K. (Kyushu Sangyo Univ., Fukuoka). Lett. Nuovo Cim.; 11: No. 1, 55-60(7 Sep 1974).

Strange K* and K** exchanges are studied using the experimental data of hypercharge exchange reactions $K^- p \to \eta\Lambda$ and $K^- p \to \eta'\Lambda$, and the validity of the nonperipheral model developed previously in which the existence of the nonperipheral, that is central component is clarified in the imaginary part of the s-channel helicity-nonflip A_2 tensor amplitude but not in the one of the ρ vector amplitude. The differential cross sections and polarization are discussed. (JFP)

1908 RESULTS FOR THE πN CROSSING-ODD FORWARD-SCATTERING AMPLITUDE FROM A NEW DISPERSION RELATION ANALYSIS. d'Angelo, S. (Univ., Rome); Ferrari, E.; Violini, G.; Srivastava, Y. Nuovo Cim., 23: No. 4, 658-668(21 Oct 1974).

A simultaneous analysis of total cross sections, real parts, charge exchange forward differential cross sections and finite-energy sum rules is performed for the crossing-odd πN forward-scattering amplitude, in order to compare several different high energy models. It is found that other singularities in the J-plane are required besides the ρ Regge pole. Some implications of one of the possible alternatives, namely the presence of a subtraction constant in the real part, are also discussed. (auth)

1909 PROPOSAL OF PHASE SHIFT ANALYSIS OF K^-, $\bar{K}-$ NUCLEON SCATTERING BASED ON FIELD THEORY. Cazzola, P. (Univ., Padua); Pusterla, M. Lett. Nuovo Cim.; 11: No. 4, 287-292(28 Sep 1974).

An analysis of the experimental data of the $K-\bar{K}-$nucleon systems that takes into account theoretical assumptions of the meson–baryon dynamics is proposed. More precisely it is shown how explicit relatively simple formulas for the partial-wave amplitudes are possible within the frame of field theory, even in a strong-

coupling problem if one joins perturbation theory and the Pade approximant method. The pseudoscalar meson–baryon model is considered, and the reactions $K + N \to K + N$, $\bar{K} + N \to \bar{K} + N$, and $\bar{K} + N \to Y + M$, where $Y = \Lambda, \Sigma$ for both isospin states $T = 0,1$. Consequently one can obtain predictions for the pion–hyperon scattering and for the associated production $\pi N \to Y + K$. (JFP)

1910 PION–NUCLEON INTERACTIONS IN LOW ENERGY REGION AND ONE-HADRON EXCHANGE MODEL. Hiroshige, N. (Osaka City Univ.); Tsujimura, T. Lett. Nuovo Cim.; 11: No. 5, 330-336(5 Oct 1974).

A result of the phenomenological analysis of pion–nucleon interactions in the low energy region below 329 MeV by the one-hadron exchange model is presented. The polarization, differential cross sections, coupling constants, and phase shifts are considered. (JFP)

1911 A PHASE CORRECTED REGGE POLE MODEL FOR $\pi^- p \to \pi^0 n$. Joynson, D. (Westfield Coll., London (UK)). Nucl. Phys., B; 79: No. 3, 381-395(25 Sep 1974).

It is assumed that the imaginary part of the Regge amplitude is given by the standard Regge pole model, but that the real part is given by fixed t-dispersion relations. The results of calculations using this method are compared with those of the Regge pole model for $\pi^- p \to \pi^0 n$ in the intermediate energy range $3 \leq P_{lab} \leq 18$ GeV/c where good fits are found to the data. The magnitude of the ρ' contribution needed is in better agreement with measurements of $\rho' \to 2\pi$ couplings than in conventional Regge pole models. (auth)

1912 QUASIPOTENTIAL APPROACH AND BACKWARD πN SCATTERING AT HIGH ENERGY. Dzhgarkava, M. I.; Garsevanishvili, V. R.; Goloskokov, S. V.; Kazarinov, Yu. M.; Matveev, V. A.; Potashnikova, I. K.; Silin, I. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). Nucl. Phys., B; 79: No. 3, 396-412(25 Sep 1974).

A statistically satisfactory description ($\chi^2/\chi^{-2} = 0.94$, C.L. = 69%) of the known experimental data on backward πN scattering in the region $-2.86\ (GeV/c)^2 \leq \mu \leq 0.06\ (GeV/c)^2$ and $p_L \gtrsim 7.8$ GeV/c is obtained in the framework of the quasipotential approach. The predictions for higher values of p_L are also given. (auth)

1913 THEORY OF THE PSEUDOSCALAR INTERACTION IN THE TWO-NUCLEON SYSTEM. Chemtob, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Service de Physique Theorique); Desplanques, B. (Centre National de la Recherche Scientifique, 91 – Orsay (France)). Nucl. Phys., B; 78: No. 1, 139-204(18 Aug 1974).

The authors discuss in general terms both covariant and non-covariant formulations of the pseudoscalar interactions in the two-nucleon (NN) and pion-nucleon (πN) systems. The equations are derived allowing one to evaluate the 2π exchange contribution to the NN scattering amplitudes and non-relativistic potentials from the knowledge of the corresponding pseudoscalar amplitudes in the πN system. Dynamical descriptions of odd-parity effects are then discussed in connection with weak interaction models based on the current-current form of the weak Hamiltonian. Calculations are presented of NN potentials due to 2π exchange contributions including πN and $\pi\pi$ rescattering effects in the strong vertices only. Two mechanisms are considered: the first induced by the vertex $N + \bar{N} \to \pi$ and the second by $N + \bar{N} \to 2\pi$ (p-wave). Restricting oneself to on-shell nucleons, the first contributes to potentials with isospin selection rule $\Delta T = 1$ and the second to potentials $\Delta T = 0,1,2$, the $\Delta T = 1$ part corresponding in the factorization approximation to G-parity odd effects and the others to the familiar ρ-exchange and triangle diagram mechanisms. It is shown that 2π exchange effects are not intrinsically small, as they appear in a significant way in components where 1π effects do not contribute. It is also suggested on the basis of a derivation of single-particle potentials, obtained by taking nuclear matter averages of our two-body potentials, that 2π effects provide for 50% ~ 10% enhancements in the magnitudes of the familiar π- and zero-width ρ-exchange contributions. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 1609, 2010, and 2017.

1914 (KHFTI-73-10, pp 24-27) ELECTROPRODUCTION OF $^{5}_{\Lambda}$He AND $^{7}_{\Lambda}$Li HYPERNUCLEI. Kozlov, M. I.; Fetisov, V. N. (Lebedev Inst. of Physics, Moscow). 1973. (In Russian).

The differential cross sections for the reactions $Z^{\Lambda}(e,e'K^+)_{\Lambda}(Z-1)^{\Lambda}$ on ^{7}Li and ^{9}Be were calculated for transitions in the lowest states of the hypernuclei $^{5}_{\Lambda}$He and $^{7}_{\Lambda}$Li. (tr-auth)

1915 (RRK-73-15) GEOMETRICAL ASPECT OF MULTIPLICITY DISTRIBUTION AND THE ELASTIC DIFFRACTION SCATTERING. Minakata, H. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Oct 1973. 13p. NTIS (US Sales Only).

A simple geometrical picture is presented which leads to the compound Poisson-type multiplicity distribution. In this picture, the specific choice of the distribution enables one to determine the inelastic overlap function. The Pólya-Eggenberger distribution is taken which was previously discussed by the present author and by others. The elastic diffraction scattering is discussed by the use of the unitarity relation. An intimate connection between the long-range property of correlations and the shrinkage behavior of the diffraction peak is found. (auth)

1916 MASSIVE-MUON-PAIR PRODUCTION AT HIGH ENERGY. Brandt, R. A.; Kaufman, A.; Preparata, G. (New York Univ., New York). Phys. Rev., D; 10: No. 1, 146-169(1 Jul 1974).

A detailed analysis of the inclusive massive-μ-pair production process in high energy proton-proton collisions is presented based on the combined assumptions of light-cone (LC) expansions and multi-Regge theory. The scaling limit is LC dominated, and the assumed strongly convergent Regge theory leads to dominance by the leading LC singularities. The resulting amplitude is expressed as a sum of two distinct contributions, a "pionization" piece, which dominates at large dimuon mass M, and a "fragmentation" piece, which dominates at smaller M. The result of the combination of these two contributions, each of fast decrease in M, can produce a shoulder in the $d\sigma/dM$ cross section, as seems to be present experimentally. This requires a small, perhaps vanishing, Pomeron-particle-Pomeron coupling at $t = 0$. A phenomenological model, which simply incorporates the derived behaviors of the scattering amplitude, is introduced to fit the data quantitatively. A good fit to the $d\sigma/dM$ data (at fixed energy) fixes the (five) parameters. The model then is compared with the experimental curves for the transverse and longitudinal dimuon cross sections and the total (energy-dependent) cross section. Good agreement is found. A comparison with the parton model is also given. (auth)

1917 MODEL FOR DIFFRACTION EXCITATION. Jaroszkiewicz, G. A. Landshoff, P. V. (Cambridge Univ., Eng.). Phys. Rev., D; 10: No. 1, 170-174(1 Jul 1974).

A model in which the Pomeron couples to quarks in a way that resembles the coupling of an SU(3)-scalar photon was previously shown to be successful for p–p elastic scattering. The analysis is now extended to the inclusive process $pp \to pX$ at small t and missing mass beyond the resonance region. There are no free parameters and agreement with published data is good. (auth)

1918 EXCHANGE MECHANISM OF PROTON–PROTON SCATTERING AND THE TREND OF POLARIZED-BEAM CROSS SECTIONS AT INTERMEDIATE ENERGIES. Halzen, F.; Thomas, G. H. (Argonne National Lab., IL). Phys. Rev., D; 10: No. 1, 344-347(1 Jul 1974).

It is shown how a few very general assumptions on the exchange mechanism in proton-proton scattering yields a simple description of the data recently obtained with the Argonne polarized beam. Predictions are presented for polarized cross sections in presently unexplored kinematic regions. The helicity amplitude decomposition of all possible observables are listed in two tables. (auth)

1919 SEARCH FOR EVIDENCE OF A $\Delta(1236)-\Delta(1236)$ COMPONENT OF THE DEUTERON. Horne, C. P. (Florida State Univ., Tallahassee); Hagopian, S.; Hagopian, V. Phys. Rev. Lett.; 33: No. 6, 380-383(5 Aug 1974).

Evidence for a bound $\Delta_{33}(1236)-\Delta_{33}(1236)$ component of the deuteron is sought by using π^+, π^-, and K^+ mesons as probes of nuclear structure. Events are observed which might contain $\Delta(1236)$ "spectators" in the breakup of a deuteron in a $\Delta\Delta$ state. However, other mechanisms may contribute to the signal, and one cannot unambiguously ascribe the events to a $\Delta\Delta$ contribution in the deuteron. With certain assumptions an upper limit of ~0.7% is obtained for the $\Delta\Delta$ component of the deuteron. (auth)

1920 DEFREEZING PARTONS AND RISING PP TOTAL CROSS SECTION. Bartelski, J.; Krolikowski, W. (Univ., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci., Math., Astron. Phys.; 22: No. 5, 545-553(Jun 1974).

A modified concept of partons, referred to as "defreezing partons" is described. The crucial point of the new concept is that wee partons are replaced by "frozen" partons, which can "defreeze" step by step leading to a step-like structure of the rising proton-proton total cross-section. Its asymptotic form is $A_0 + A_1 \log(s/s_0) + A_2 \log^2(s/s_0)$. (auth)

1921 SIMPLE GEOMETRIC INTERPRETATION OF INCREASING ASSOCIATED MULTIPLICITY WITH INCREASING TRANSVERSE MOMENTUM. Barshay, S.; Yamaguchi, Y. (State Univ. of New York, Stony Brook). Contract AT(11-1)-3001. Lett. Nuovo Cim.; 10: No. 18, 809-814(31 Aug 1974).

A recent experimental study of the processes $p + p \rightarrow (MM) + p$ at 28.5 GeV provided evidence for an increase in the average multiplicity of produced charged particles with increasing transverse momentum to the fast proton in the final state, for fixed large missing masses. An interpretation is given in the geometrical picture for the collision of two hadrons, extended to production processes with the intuitive notion that the average number of particles produced is greater at smaller impact parameters. (LBS)

1922 A NEW CONTRIBUTION TO DEUTERON SCREENING AT HIGH ENERGIES. Lehman, E. (Science Research Council, Daresbury (UK). Daresbury Lab.). Phys. Lett., B; 51: No. 3, 263-266(5 Aug 1974).

Effects arising from the structure of the Pomeron are shown to lead to a decrease in the apparent size of the Glauber screening correction to the π-d total cross section. This decrease is large enough to partially cancel effects arising from the usual inelastic intermediate state corrections to Glauber. (auth)

1923 PIONIZATION EFFECTS IN NUCLEON-NUCLEUS SCATTERING. Harrington, D. R. (Karlsruhe Univ. (TH) (F. R. Germany). Inst. fuer Theoretische Kernphysik). Phys. Lett., B; 51: No. 3, 287-290(5 Aug 1974).

A simple unitary model for meson production in nucleon-nucleon scattering is extended to nucleon-nucleus scattering. In the high energy limit the produced mesons remain coherent with the projectile over the entire depth of the nucleus and tend to increase the total cross sections. A crude estimate of the size of the effect gives an increase of the total cross section for proton-deuteron scattering of 13 mb at NAL energies. (auth)

1924 ON THE SHRINKAGE OF THE DIFFRACTION PEAK IN pp SCATTERING. Martin, A. (Durham Univ. (UK)). Nucl. Phys., B; 77: No. 2, 226-239(4 Aug 1974).

The shrinkage of the differential cross section is studied at ISR energies by means of an effective-trajectory plot. It is found that α_{eff} is linear in t, up to the dip region with slope $\alpha' = 0.22 \pm 0.02$. The suggestion that the pomeron behaves as a simple Regge-pole is shown to be compatible with elastic scattering data for pp and $\bar{p}p$ scattering down to incident momentum of 8 GeV/c. This model predicts that the total cross section for pp scattering remains approximately constant at 42.5 mb throughout the NAL energy range. The energy dependence of the partial-wave amplitudes at ISR energies is also studied. (auth)

1925 MUELLER-REGGE ANALYSIS IN THE CENTRAL REGION. Inami, T. (Science Research Council, Chilton (UK). Rutherford Lab.). Nucl. Phys., B; 77: No. 2, 337-359(4 Aug 1974).

Mueller-Regge analysis of inclusive spectra in the central region for fixed $P_\perp$ is carried out from 12 GeV/c to ISR energies. An analysis of the difference between π^+ and π^- single-particle spectra reveals that both Mueller-Regge energy dependence and factorization are in accord with experiments only in a limited region of moderate value of $p_\perp$, i.e., $p \gtrsim 0.7$ GeV/c. This suggests that double Regge exchange is a good approximation only for $|t|$ and $|u| \gtrsim 4$ GeV^2. The K/π ratio calculated on the basis of an additive quark-counting picture is also consistent with experiments inside this region. The P_ρ central vertex determined from ISR data turns out to be much smaller than one would obtain from low energy (12-24 GeV/c) data. The P-M-P exchange contribution to $\pi\pi$ correlations in rapidity thus estimated can explain only a part of observed correlations, which indicates that there should be a large positive contribution from some other effects, such as long range effects and/or Q exchange. The transverse momentum dependence of the P_ρ central vertex also determined from ISR data predicts that the P-ρ-P exchange contribution to normalized $\pi\pi$ correlations increases as p_1 and p_2 increase. (auth)

1926 TRIPLE-REGGE ANALYSIS OF $pp \rightarrow pX$ AND SOME RELATED PHENOMENA—A DETAILED STUDY. Roy, D. P.; Roberts, R. G. (Science Research Council, Chilton (UK). Rutherford Lab.). Nucl. Phys., B; 77: No. 2, 240-268(4 Aug 1974).

A phenomenological analysis of all available data on the reaction $pp \rightarrow pX$ is carried out, using the triple-Regge formalism and the technique of finite mass sum rules. Various inconsistencies in the data are discussed and it is pointed out how such ambiguities can be resolved. The results show that diffraction scattering is dominated by the triple-pomeron term which shows no tendency to vanish at $t = 0$. By parametrizing the values of the trajectories and couplings resulting from the fits to data, the most likely description of inelastic diffractive scattering is obtained. This description predicts that the diffractive cross section would rise by 3.3 mb between 200 and 2000 GeV/c (experimentally σ_{inel} rises by 3.8 ± 0.8 mb). The connection between these two increases according to several models is then discussed in the context of the estimates. Finally the implications of the analysis for the multiplicity distributions and long-range effects in multiparticle production are discussed. (auth)

1927 A DESCRIPTION OF $pp \rightarrow pX$ IN THE TRIPLE-REGGE REGION INCORPORATING f/P UNIVERSALITY. Balazs, L. A. P. (Purdue Univ., Lafayette, Ind. (USA). Dept. of Physics). Phys. Lett., B; 51: No. 2, 169-171(22 Jul 1974).

By assuming generalized f/P universality and exchange degeneracy, one can considerably reduce the number of independent triple-Regge parameters needed to fit the recent NAL measurements of the $pp \rightarrow pX$ cross section. (auth)

1928 PION PRODUCTION IN TWO-BODY pd COLLISIONS. Locher, M. P.; Weber, H. J. (Virginia Univ., Charlottesville (USA)). Nucl. Phys., B; 76: No. 3, 400-412(18 Jul 1974).

The reactions $d(p,\pi^+)t$ and $d(p,\pi^0)\,^3He$ are analyzed in terms of the $pp \rightarrow \pi^+ d$ sub-process. The exclusion principle induces an additional exchange contribution involving the πd scattering amplitude. Acceptable deuteron and triton (^{3}He) wave functions which reproduce the charge form factors yield results consistent with experimental angular distributions at 470, 590, 754 and 1192 proton lab. energies. The forward peak is not sensitive to details of the wave functions. Both the direct and exchange form factors develop a zero which is imposed by the dip in the ^{3}He charge form factor. The associated interference pattern governs the backward cross section. (auth)

1929 DUALITY IN MASSIVE LEPTON-PAIR PRODUCTION. Sakurai, J. J. (California Univ., Los Angeles (USA). Dept. of Physics); Thacker, H. B. (State Univ. of New York, Stony Brook (USA). Inst. for Theoretical Physics). Nucl. Phys., B; 76: No. 3, 445-452(18 Jul 1974).

Using duality in the q^2 variable massive lepton-pair production in proton–proton collisions at all values of m^2 (lepton-pair mass squared) and s is related to the inclusive production of $\rho(\omega)$ mesons. (auth)

1930 NUCLEAR CASCADE AND RANGE OF SPALLATION HYPERFRAGMENTS. Goel, S. P. (Kurukshetra Univ., India); Singh, T.; Prakash, Y. Indian J. Pure Appl. Phys.; 12: No. 4, 286-289(Apr 1974).

The role of nuclear cascade in determining the range of spallation hyperfragments is examined and found to be significant. The production of such hyperfragments from the interaction of K^--mesons (stopping and of energy 0.8, 1.5, and 3.5 GeV/c) with the heavy emulsion nuclei is studied through Monte Carlo calculations. The results show that agreement between the observed and the calculated range spectra of spallation HFs is produced if the contribution of the nuclear cascade to the calculated momentum (and consequently to the range) of the hyperfragments is chosen from an experimentally derived distribution. (auth)

1931 NEGATIVE ENERGY CONTRIBUTIONS TO RADIATIVE np CAPTURE. Dressler, E. T. Jr. Washington, DC; American Univ. (1974). 89p. University Microfilms Order No. 74-20,885. Thesis (Ph. D.).

The discrepancy between the experimental and theoretical np capture cross section has been a problem for nuclear theorists for a long time. Within the framework of the impulse approximation, theorists had only come to within about 11% of the 334.2 ± 0.5 mb experimental cross section. In an attempt to resolve this discrepancy, several calculations have been done recently which have added meson exchange corrections to the impulse approximation. These calculations have essentially resolved this discrepancy and have shown that the largest meson exchange corrections come from the case when the intermediate state nucleon is in a negative energy state. The purpose of this calculation is to present an alternate method of calculating these negative energy corrections by introducing negative energy wave functions which sum the contributions from heavier mesons in addition to the pion. The results of this calculation show that this method is a useful approach to calculating the negative energy corrections and should be applicable to other few-nucleon processes. (Diss. Abstr. Int., B)

1932 PHENOMENOLOGICAL ANALYSIS OF BACKWARD $^2H(p,p)^2H$ BETWEEN 14 AND 2500 MeV. Dubal, L. (S. I. N., Villigen, Switzerland); Perdrisat, C. F. Lett. Nuovo Cim.; 11: No. 4, 265-270(28 Sep 1974).

The body of backward pd data at 14 MeV to 2.5 GeV is examined. Clear evidence is found in the data that at least one other mechanism plays an important role besides one-nucleon exchange at least for proton energies between 350 and 1300 MeV. Although this mechanism cannot be uniquely identified, a few arguments are presented based entirely on the analysis of the data, which are in qualitative agreement with predictions derived from calculations with graphs allowing for meson-plus-nucleon exchange. This may well occur in one of the forms considered previously. These arguments are largely independent of ambiguities in the choice of the proper variable to represent the data or of any model-dependent assumption. The differential cross sections are discussed. (JFP)

1933 ORIGIN OF THE DUAL ABSORPTION. Takagi, F. (Dalhousie Univ., Halifax, Nova Scotia). Lett. Nuovo Cim.; 11: No. 1, 21-28(7 Sep 1974).

It is shown that dual absorption geometrical models can be explained qualitatively (at least at very high energies) by combining the Lee–Veneziano model for the pomeron with a geometrical picture for multiparticle production. As an illustration these general results including the impact-parameter amplitude are applied to proton–proton and antiproton–proton scattering at 20 to 320 GeV/c. The results suggest that in addition to the dual geometrical effect proposed, at least a strong absorption effect in the usual sense may also have to be taken into account in order to achieve sufficient peripherality at low energies. The role of the real part at lower energies is discussed. (JFP)

1934 MODELS FOR HIGH-ENERGY INCLUSIVE PROCESSES AND SCREENING IN DEUTERIUM. Kwiecinski, J.; Lesniak, L.; Zalewski, K. (Institute of Nuclear Physics, Krakow (Poland)). Nucl. Phys., B; 78: No. 2, 251-268(25 Aug 1974).

The screening correction to the high energy ($p_{lab} \gtrsim 10$ GeV/c) elastic hadron-deuteron scattering amplitude is discussed. It is found that the correction cannot completely be calculated using as input only the data for cross sections of inclusive reactions on free nucleons. Nevertheless measurements of high energy screening corrections provide sensitive tests for models of inclusive processes. In particular elastic screening does not dominate over the inelastic screening if, as indicated by recent fits, the triple pomeron coupling does not vanish for three mass-zero pomerons. If this is the case, the theory of high energy elastic scattering on heavier nuclei would have to be reconsidered. The discussion is illustrated by a numerical calculation for elastic πd scattering in the 10 GeV–2000 GeV energy range. (auth)

1935 APPROXIMATION METHOD FOR HIGH ENERGY SCATTERING AT LARGE ANGLES. Chen, T. W. (New Mexico State Univ., Las Cruces). Lett. Nuovo Cim.; 11: No. 5, 315-320 (5 Oct 1974).

A new formula for describing the scattering amplitude of a high energy particle by a nucleus is presented. This formula has the nice property of the Glauber-type additivity and works also for large angle scattering. (JFP)

1936 ABSORBED INDEPENDENT-EMISSION MODEL FOR MULTIPARTICLE PRODUCTION AND DIFFRACTIVE SCATTERING IN HIGH ENERGY HADRON COLLISIONS. Chiu, C. B.; Wang, K. H. (Univ. of Texas, Austin). Lett. Nuovo Cim.; 11: No. 5, 321-329(5 Oct 1974).

Differential cross sections are considered for the reaction $pp \to pp + n\pi$. A solution with the absorbed independent-cluster emission model which gives a simultaneous description to the elastic scattering and the inclusive p_t distribution. The analysis suggests that there is, if any, only a weak correlation between the transverse momenta of the leading protons and those of the pions in high energy pp collisions. (JFP)

1937 INTERPRETING DATA FROM POLARIZED PROTON BEAMS. Kane, G. L.; Sukhatme, U. P. (Michigan Univ., Ann Arbor (USA). Dept. of Physics). Nucl. Phys., B; 78: No. 1, 110-128(18 Aug 1974).

The reactions $pp \to pp$ and $pp \to \Delta^{++}n$ with polarized beam and/or polarized target are currently under investigation at the Argonne ZGS. The authors discuss how to interpret various measured quantities in terms of amplitudes whose behavior is familiar (as functions of s,t). For pp total cross sections and elastic scattering, Argonne measurements will yield Im φ_2 (s,t = 0) and the rather complicated combination $2|\varphi_5|^2 + \mathrm{Re}\,(\varphi_1\varphi_2^* - \varphi_3\varphi_4^*)$, where φ_i (i = 1, ..., 5) are conventional s-channel helicity amplitudes. The forward direction (t = 0) is of special interest. It is found that for both $pp \to pp$ and $pp \to \Delta^{++}n$, polarized beam—polarized target experiments plus the rather general (testable) assumption that amplitudes with the same s-channel helicity flip quantum numbers are proportional, are sufficient to fully determine all non-vanishing amplitudes at t = 0. Numerical estimates of some observables, based on calculations in a specific model, are also given. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstract 1983.

1938 HARMONIC ANALYSIS IN SO(4,1) GROUP SPACE. Minn, H. K. Seoul Nat. Univ. Fac. Pap., Sci. Technol. Ser. C; 2: 21-25(1973).

The unitary, irreducible representations of SO (4, 1) are derived. The properties of these representations are discussed, and the explicit form of the corresponding hyper-harmonic function are given. The orthogonality is proved with respect to the invariant measure in SO (4, 1) group space. (Korean Sci. Abstr.)

1939 SUPER-GAUGE TRANSFORMATIONS. Salam, A.; Strathdee, J. (International Centre for Theoretical Physics, Trieste (Italy)). Nucl. Phys., B; 76: No. 3, 477-482(18 Jul 1974).

In a recent article Wess and Zumino have invented an interesting new symmetry. Generalizing from the dual model super-gauge symmetry these authors succeeded in defining an analogous transformation group in four-dimensional space-time. This invention is quite remarkable in at least two respects: (i) the irreducible representations of this symmetry combine fermions with bosons and (ii) the strictures of O'Raifeartaigh's theorem are circumvented—there seems to be a relativistic spin-containing symmetry which is consistent with unitarity. Moreover, in a simple Lagrangian model involving two scalars and a Majorana spinor, Wess and Zumino found that, in the one-loop approximation, there is only one (logarithmic) divergence. A rather simple method which can be used for the construction of at least some of the representations of this symmetry is presented. (auth)

1940 SUPER-GAUGE TRANSFORMATIONS ON THE SIX-DIMENSIONAL HYPERCONE. Ferrara, S. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 77: No. 1, 73-90(25 Jul 1974).

Super-gauge transformations on physical space-time are defined on the projective six-dimensional hypercone. The basic observation which motivates the present approach is that the product of any two super-gauges is a general conformal ($+_{TS}$) transformation and indeed these latter transformations are simply realized on the six-dimensional hypercone. It turns out that also super-gauge transformations have a natural action on this projective space where the parameters of such transformations are (totally anti-commuting) spinors which transform according to the fundamental (eight-dimensional) representation of the spinor group SU(2,2), isomorphic to the conformal group. The enlarged algebra of super-gauges, conformal and chiral transformations and its most relevant representations are discussed in the present formalism. (auth)

1941 AUTOMODEL SOLUTIONS FOR MATRIX ELEMENTS OF CURRENTS IN CONFORMAL INVARIANT THEORIES. Matveev, V. A.; Robschik, D.; Tavkhelidze, A. N.; Wieczorek, E. (Joint Inst. for Nuclear Research, Dubna (USSR)). Phys. Lett., B; 51: No. 2, 146-148(22 Jul 1974).

All solutions of the equations expressing conformal invariance for one-particle matrix elements of the product of two scalar or conserved vector currents have been obtained, taking into account polynomial boundedness, causality and spectrum conditions. (auth)

1942 CALCULABLE CORRECTIONS TO HADRONIC ZEROTH ORDER RELATIONS IN UNIFIED GAUGE MODEL. Bars, I. (Stanford Univ., Calif. (USA). Inst. of Theoretical Physics). Phys. Lett., B; 51: No. 3, 267-271(5 Aug 1974).

Hadronic symmetry breaking in unified gauge models is formulated in terms of measurable currents and their divergences. The model independent method consists of calculating the divergence $\partial^\mu J_\mu^a$ to order e^2, as an operator. Formulas are derived for the pion mass, pi-pi scattering lengths, pi-nucleon sigma term, corrections to the Goldberger–Treiman relation, physical baryon mass splitting, and a possible mechanism for pi-eta degeneracy breaking is given. Renormalizability puts short distance conditions on the currents. (auth)

1943 ALGEBRAIC PROPERTIES OF SU(4) × SU(4) SYMMETRY BREAKING. Mott, R. E. (Queen Mary Coll., London (UK)). Nucl. Phys., B; 76: No. 2, 301-309(11 Jul 1974).

The geometrical ideas of Michel and Radicati are applied to the groups SU(4) and SU(4) ⊗ SU(4), and results similar to those obtained at the SU(3) level are proved. In particular, the requirement that the directions of charge and hypercharge correspond to vectors on critical orbits restricts the choice of quantum numbers for the four hadronic quarks; it is also found that the directions of strong interaction breaking proposed in two recent papers are very close to a critical orbit. (auth)

1944 C,P,T, AND THE DIRAC FORMALISM. Hill, R.C. (Department of Physics, Southern Illinois University, Edwardsville, Illinois 62025). Am. J. Phys. 42: No. 11, 976-984 (Nov 1974).

A method of dealing with charge conjugation and other discrete symmetries for Dirac particles is presented using a manifestly covariant notation which is simple to work with and which can be used in any representation of the Dirac matrices not explicitly involving the usual "B" and "C" matrices presented in many textbooks. Its use is illustrated by its application to discrete symmetries of the Dirac equation, field operators, and transition—matrix elements and in defining phase conventions for spinors. The linear—versus—antilinear nature of charge conjugation is also discussed. (auth)

1945 A THEORETICAL ARGUMENT FOR SOMETHING LIKE THE SECOND MELOSH TRANSFORMATION. Bell, J. S.; Hey, A. J. G. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Lett., B; 51: No. 4, 365-366(19 Aug 1974).

The search for a relativistic SU(6) has centered for some time on the $SU(6)_W$ of light plane charges. The attempt to regard this as a symmetry group, i.e., to identify this $SU(6)_{W,currents}$ with $SU(6)_{W,constituents}$ runs into a striking contradiction with experiment as regards the nucleon anomalous magnetic moments—they would have to be zero. Now Melosh has given indications that such symmetry would not even be theoretically possible, because of conflict with requirements of ordinary rotation invariance. Unfortunately these indications are based on the simulation of bound states by free quark and antiquark wave packets, so that not everyone has been convinced. Here we give a serious and quite simple demonstration that this hypothetical symmetry, when combined with ordinary rotation and Lorentz invariance, would indeed exclude the existence of at least the simplest composite system, the $35(I_3 = 0)$ mesons. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstracts 1611, 1708, 1837, and 2011.

1946 THE NEUTRON ELECTRIC DIPOLE MOMENT AS A TEST OF THE SUPERWEAK INTERACTION THEORY. Wolfenstein, L. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 77: No. 3, 375-385(11 Aug 1974).

Theoretical calculations of the neutron electric dipole moment D_n are reviewed for various theories of CP violation. It is shown that for the superweak interaction theory D_n is less than 10^{-29} e · cm in contrast to values of 10^{-23} to 10^{-24} predicted by many but not all milliweak theories. It is concluded that prospective measurements of D_n may provide decisive evidence against or significant evidence in favor of the superweak theory. (auth)

1947 $|\eta_+|$ AND THE REACTION $e^+e^- \to K^0\bar{K}^0$ AT THE ϕ-RESONANCE. Dass, G. V. (Science Research Council, Chilton (UK). Rutherford Lab.). Phys. Lett., B; 51: No. 3, 247-250 (5 Aug 1974).

$|\eta_+|$ can be rather cleanly determined in $e^+e^- \to K^0\bar{K}^0$ at the ϕ-resonance position from the $\pi^+\pi^-$ time-distribution of decays of one of the produced kaons within a suitable angular portion of a hemisphere. The procedure is better than the existing methods. (auth)

1948 ELECTROMAGNETIC AND CP VIOLATING EFFECTS AS THE ORIGIN OF THE DEPARTURES FROM THE EXACT $\Delta I = \frac{1}{2}$ RULE. Gavroglu, K. (State Univ. of New York, Stony Brook (USA)). Nucl. Phys., B; 78: No. 1, 129-138(18 Aug 1974).

The possibility that the departures from the exact $\Delta I = \frac{1}{2}$ rule in the $B \to B'\pi$ decays can be explained with mechanisms other than the contributions of the 27-plet is investigated. Model dependent indications that electromagnetic and CP violating effects may account for these departures are found. Experiments involve large errors, and one cannot test the conjectures with the available data. It is also shown, that the $\Lambda\pi$ phase shifts determined from the Ξ and Ξ^0 decays are not consistent with time reversal invariance. (auth)

Applications (Strong)

1949 WHY AND HOW TO MAKE CONSTITUENT AND CURRENT QUARKS DIFFERENT. de Alwis, S. P. (European Organization for Nuclear Research, Geneva (Switzerland)); Stern, J. (Paris-11 Univ., 91—Orsay (France). Div. de Physique Theorique). Nucl. Phys., B; 77: No. 3, 509-544(11 Aug 1974).

In the absence of $SU(6)_W$ invariance breaking the symmetry generators, which classify hadronic states into degenerate $SU(6)_W$ multiplets, may be identified with the good components of observable local non-conserved currents integrated over a null plane (the light-like charges Q^α, Q_i^α), as is suggested by the free quark model. The breakdown of both $SU(6)_W$ and SU(3) invariance of the Hamiltonian requires the existence of a unitary transformation $U \neq 1$, which distinguishes and relates the observable light-like charges Q^α, Q_i^α and the symmetry operators W^α, W_i^α, classifying the observed hadrons into mass non-degenerate $SU(6)_W$ multiplets. A general form of the transformation U is constructed in a broad class of quark field theories and it is then used to abstract from these theories new algebraic structures, which describe the effects of $SU(6)_W$ and SU(3) invariance breaking on certain observables. Some predictions valid in the invariance limit remain unaffected to all orders of $SU(6)_W$ and SU(3) invariance breaking ($D/F = 2/3$ ratio for the isovector axial charges, relations between eN and νN inelastic scattering scaling functions, a few relations among magnetic moments, etc.), some are improved ($\Delta S = 1$ weak transitions, Δ-N-γM_1 transition) and some are completely removed ($g_A = \frac{5}{3}$, $\mu_{\hat{N}} = 0$, etc.). (auth)

1950 SU_3 NONINVARIANCE OF THE VACUUM AND THE (3,3) + (3,3) MODEL OF $SU_3 \times SU_3$ SYMMETRY BREAKING. Sinha, P.; Gautam, V. P. (Indian Association for the Cultivation of Science, Calcutta). Lett. Nuovo Cim.; 11: No. 1, 83-87 (7 Sep 1974).

The problem of how the $SU(3) \times SU(3)$ symmetry is broken is considered. The Gell-Mann, Oakes, and Renner model and πK scattering amplitudes are considered. It is noted that the consistency of this postulate with the (3,3) + (3,3) model of $SU(3) \times SU(3)$ symmetry breaking provokes a generalization of the basic idea of the postulate. Also it is not unreasonable to think that not only for the hadrons but perhaps also for all the physical entities in nature the symmetry properties exhibited are inherent in the vacuum. (JFP)

1951 LINEAR OR QUADRATIC BARYON SU_3-BREAKING MASS FORMULAE. Lichtenberg, D. B. (Indiana Univ., Bloomington). Contract AT(11-1)-2009. Lett. Nuovo Cim.; 11: No. 4, 249-252(28 Sep 1974).

It is pointed out that there is no evidence that a mass-squared formula holds better than a linear mass formula for any baryon multiplet other than the decimet. It is concluded that present data do not support the advocates of either linear or quadratic first-order baryon mass formulas, but are consistent with the Okubo linear or quadratic second-order formula. (JFP)

Scattering Theory

Refer also to abstracts 1868, 2292, and 2314.

1952 PARTIAL-WAVE ANALYSIS OF DUAL AMPLITUDE WITH THE MANDELSTAM ANALYTICITY. Enkovskii, L. L. Teor. Mat. Fiz.; 20: No. 3, 338-352(Sep 1974). (In Russian).

Partial-wave projection of the dual amplitude with the Mandelstam analyticity is studied. It is shown that the resonances in this model are completely reggeized. From the viewpoint of the structure of the J-plane the trajectories turn out to be preferable, which satisfy the asymptotical bound $O(\ln^{1+\epsilon} s) \leq |\alpha(s)| \leq O(s^{1/2})$, and the only singularities of which in the J-plane are the poles lying on the parent and daughter trajectories and also in the nonsense points of wrong signature. From the viewpoint of two-particle unitarity condition preferable ones are the trajectories, which take semi-integer values at the threshold. (auth)

1953 ON THE SELF-CONSISTENT POMERON POLE. Kwiecinski, J. (Institute of Nuclear Physics, Krakow (Poland)). Phys. Lett., B; 51: No. 3, 283-286(5 Aug 1974).

A model is considered in which a Pomeron is regarded as a self-consistent intercept one Regge pole resulting from a Bethe—Salpeter-like equation in Reggeon theory. The absorptive nature of a two Pomeron cut is crucial for realization of self-consistency. For zero mass Pomerons the model predicts the vanishing of the triple Pomeron coupling and softening of Pomeron cut contributions to inclusive reactions in triple and di-triple Regge regions. (auth)

1954 DIAGONALIZATION OF THE INELASTIC UNITARITY EQUATIONS. Klink, W. H. (Institute of Nuclear Research, Warsaw (Poland)). Nucl. Phys., B; 77: No. 1, 56-72(25 Jul 1974).

It is shown that previously derived inelastic unitarity equations can be completely diagonalized by using time reversal invariance. It is then shown that this result is valid for arbitrary inelastic processes, if the operator equations are interpreted as acting on a suitably defined direct sum space containing the $2 \rightarrow N$ partial-wave amplitudes. The effect of internal symmetries and spin on the unitarity equations is also discussed. (auth)

1955 CONSTRUCTION ON UNITARY, ANALYTIC SCATTERING AMPLITUDES. (III). Practical Application to $\alpha\alpha$ Scattering. Atkinson, D.; Kok, L. P.; de Roo, M. (Rijksuniversiteit Groningen (Netherlands). Instituut voor Theoretische Natuurkunde); Johnson, P. W. (Illinois Inst. of Tech., Chicago (USA)). Nucl. Phys., B; 77: No. 1, 109-133(25 Jul 1974).

A practical method for exploring continuum ambiguities in phase-shift analysis is discussed, and the techniques are applied to $\alpha\alpha$ elastic scattering, above the inelastic threshold. Very considerable ambiguity corridors are generated. (auth)

1956 OPTIMALLY-WEIGHTED DISPERSION RELATIONS. II. Shepard, H. K. (New Hampshire Univ., Durham (USA). Dept. of Physics); Shih, C. C. (Tennessee Univ., Knoxville (USA). Dept. of Physics). Nucl. Phys., B; 77: No. 1, 134-140(25 Jul 1974).

The optimally-weighted dispersion relation and extrapolation error are constructed for an amplitude with unequal, possibly correlated, errors in the experimental boundary values of its real and imaginary parts. The uniqueness of the optimally-weighted dispersion relation is demonstrated. (auth)

1957 CONSTRAINTS ON THE PHASES OF HELICITY AMPLITUDES DUE TO POSITIVITY. Cornille, H. (Rockefeller Univ., New York (USA)); Martin, A. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 77: No. 1, 141-162(25 Jul 1974).

From the positivity of the expansion coefficients of the absorptive part of a helicity non-flip, elastic scattering amplitude bounds are obtained on the phase of the corresponding helicity non-flip amplitude. For helicity-flip amplitudes bounds are obtained on the local variation of the phase between two positive scattering angles. (auth)

1958 SOLUTION OF THE LANE EQUATIONS AND SOME SPECTROSCOPICAL INFORMATION. Popescu, D. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 25: No. 9, 1053-1074(1973). (In Rumanian).

A qualitative discussion of the coupled equations in the scattering problems is given. The system is particularized for the problem of isobaric analog resonances, obtaining the well known Lane's equations. These equations were solved using some general and particular methods, the aim being the obtaining of the spectroscopical information. (auth)

1959 INTEGRAL EQUATIONS FOR FOUR IDENTICAL PARTICLES WITH SEPARABLE TWO-PARTICLE INTERACTIONS. Kharchenko, V. F.; Kuzmichev, V. E. (Inst. for Theoretical Physics, Kiev). Czech. J. Phys.; 24: No. 10, 1071-1090 (1974).

The problem of four identical spinless particles with separable two-particle interactions is considered. The integral equations of motion for four particles in the bound states and in the continuum states with two noninteracting subsystems in the initial channel are formulated. The angular-momentum reduction of the obtained equations is given. (auth)

1960 FINITENESS OF THE DISCRETE SPECTRUM IN THE QUANTUM n-PARTICLE PROBLEM. Zhislin, G. M. (Gorky Scientific-Research Radiophysical Inst., USSR). Teor. Mat. Fiz.; 21: No. 1, 60-73(Oct 1974). (In Russian).

Sufficient conditions are found for the finiteness of the discrete spectrum of energy operators of quantum many-particle systems in spaces of the functions with given symmetry. In many cases these conditions make it possible to reduce the problem of the finiteness of the discrete spectrum of energy operator of the many-particle system to the analogous problem for the two-particle system. (auth)

1961 SINGULAR QUASIPOTENTIAL EQUATION. Gogokhiya, V. Sh.; Filippov, A. T. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 21: No. 1, 37-48(Oct 1974). (In Russian).

Quasipotential equation for the partial wave scattering amplitude is investigated. The integral equation for the singular potential $V(r) = gr^{-4n+1}$ (n−integer, ≥1) is reduced to the inhomogeneous differential equation with certain boundary conditions. In the case $n = 2$, $l > 0$ the existence and the uniqueness of the solution is proved. A method of constructing solution for the S-wave ($l = 0$) by means of analytic continuation is proposed. It is shown that the solution obtained by this method satisfies the integral equation with the quasipotential, which differs from the analytical continuation of the original quasipotential by a certain polynomial. The solutions obtained can be represented in the form of the series in powers of $g^{\nu}(\ln g)^{a\nu}$ (a modified series of the perturbation theory). The approximate method of investigating the quasipotentials with arbitrary (non integer) n is suggested. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

1962 (CONF-740725-1) LONG WAVELENGTH EXCITATIONS AND THE ATTENUATION OF SOUND IN LIQUID ^{4}He. Ketterson, J. B.; Abraham, B. M.; Roach, P. R. (Argonne National Lab., Ill. (USA)). [nd]. 44p. Dep. NTIS $5.25.

A brief review is given of current understanding of the behavior of long wavelength excitations in liquid ^{4}He at very low temperatures and their dependence on pressure. A discussion is given of experiments which probe the excitation spectrum; these include inelastic neutron scattering, heat capacity, thermal conductivity, propagation of super thermal phonons, and sound propagation. Special emphasis is given to sound propagation. (auth)

1963 (CONF-741008-3) DIELECTRIC STRENGTH OF LIQUID HELIUM IN MILLIMETER GAPS. Schwenterly, S. W.; Gauster, W. F.; Kernohan, R. H.; Long, H. M.; Menon, M. M. (Oak Ridge National Lab., Tenn. (USA)). 1974. 13p. Dep. NTIS $4.00.

From conference on electrical insulation and dielectric phenomena; Downington, Pennsylvania, USA (21 Oct 1974).

Previously a program underway at Oak Ridge National Laboratory to investigate the high voltage electrical properties of fluids and solids for cryogenic systems was described. As the first result of these investigations, measurements of the breakdown strength of liquid helium boiling at atmospheric pressure, under voltages up to ±130 kV dc and in gaps of up to 2.5 mm, are reported. Preliminary results with ac voltage were also obtained. (MHR)

1964 SPIN WAVES IN SUPERFLUID ^{3}He: HYDRODYNAMIC REGIME. Combescot, R. (Laboratory of Atomic and Solid State Physics, Cornell University, Ithaca, New York 14850). Phys. Rev. Lett. 33: No. 16, 946-949 (14 Oct 1974).

It is shown that spin waves exist in the hydrodynamic regime in superfluid ^{3}He. Hydrodynamic equations ruling these spin waves are derived. Spin waves are studied in the axial (Anderson–Brinkman–Morel) and in the isotropic (Balian–Werthamer) states. (auth)

1965 NMR SHIFT AND NMR LINEWIDTH IN SUPERFLUID ^{3}He. Combescot, R.; Ebisawa, H. (Laboratory of Atomic and Solid State Physics, Cornell University, Ithaca, New York 14850). Phys. Rev. Lett. 33: No. 14, 810-813 (30 Sept 1974).

A set of equations is given, which allows us to rederive both the results of Leggett (hydrodynamic regime) and of Maki and Ebisawa (collisionless regime) for NMR in superfluid ^{3}He. The NMR linewidths for both transverse and longitudinal resonance are derived by introducing a relaxation–time approximation. The results are in good agreement with experimental data. (auth)

1966 PHASE DIAGRAM OF LIQUID ^{3}He BETWEEN 0.7 AND 2.5 mK. Ahonen, A.I.; Haikala, M.T.; Krusius, M.; Lounasmaa, O.V. (Low Temperature Laboratory, Helsinki University of Technology, SF–02150 Otaniemi, Finland). Phys. Rev. Lett. 33: No. 11, 628-631 (9 Sept 1974).

We describe a nuclear demagnetization cryostat in which liquid ^{3}He has been cooled to below 0.7 mK. Data on the boundaries between the normal Fermi–liquid and the superfluid phases of ^{3}He, as determined from NMR measurements, are presented between 0.7 and 2.5 mK and from 0 to 27 bar. The "λ point" of ^{3}He was found at 0.93 mK. (auth)

1967 SUPERFLUID MASS OF LIQUID HELIUM THREE. Yanof, A.W.; Reppy, J.D. (Laboratory of Atomic and Solid State Physics and The Materials Science Center, Cornell University, Ithaca, New York 14850). Phys. Rev. Lett. 33: No. 11, 631-634 (9 Sept 1974).

Fourth sound has been generated and detected in the superfluid phases of liquid ^{3}He by means of a new technique. (auth)

1968 ANISOTROPY IN THE B PHASE OF He^3. Brinkman, W.F. (H. C. Ørsted Institute, University of Copenhagen, Copenhagen, Denmark); Smith, H.; Osheroff, D.D.; Blount, E.I. Phys. Rev. Lett. 33: No. 11, 624-627 (9 Sept 1974).

The magnetic anisotropy of the B phase (assumed to be a Balian–Werthamer phase) is investigated within the Landau–Ginzburg theory. The anisotropy is determined by the action of the dipolar energy and the magnetic field on a single vector $\vec{n}$ and it is shown that walls will induce variations in $\vec{n}$ on a scale of $R_C \sim 0.1$ cm. In the presence of a field H this characteristic length becomes $R_C H_B/H$, where H_B is of the order of 100 Oe. (auth)

1969 COMMENTS ON "QUALITATIVE EXPLANATION OF PELLAM'S HELIUM PARADOX". Lynch, R. (Physics Department, University of California, Irvine, California 92664). Phys. Rev. A 10: No. 4, 1435-1436 (Oct 1974).

The paper of Penney, concerning the role of "heat–exchange" torques in the "λ–point anomaly" of Pellam, is examined. It is shown, using only the equations and assumptions of Penny's paper, that the heat–exchange torque reduces to simply a torque produced by the inertia of counterflow. His calculations of the sense and temperature dependence of the torque are shown to be in error. It is shown in the light of these results that little effect on the "λ–point anomaly" would be expected for an assumed approximately isotropic room–temperature radiation. (auth)

1970 IMPULSE GIVEN TO A PLATE BY A QUANTIZED VORTEX RING. Cross, M.C. (Cavendish Laboratory, University of Cambridge, England). Phys. Rev. A 10: No. 4, 1442-1445 (Oct 1974).

It is shown that a quantized vortex ring in superfluid He^4, moving freely towards a flat plate, gives to it an impulse equal to the fluid impulse of the ring, provided only that the radius of the plate is larger than the initial vortex radius but smaller than the distance to the source of the ring. This is in agreement with experiment, in contradiction to two previous theoretical analyses. (auth)

1971 DIELECTRIC MODEL OF ROTON INTERACTIONS IN SUPERFLUID HELIUM. Titulaer, U.M.; Deutch, J.M. (Department of Chemistry, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. A 10: No. 4, 1345-1354 (Oct 1974).

The interactions between rotons in superfluid helium are similar to those between dipoles in a polar fluid. Models developed to describe polar fluids may therefore be used to study the influence of roton interactions on various physical quantities in helium II. In this paper we use the Onsager model of a dielectric to calculate the temperature dependence of the energy of the roton minimum in the excitation spectrum, the entropy density, and the normal fluid density, at three different pressures. The results obtained agree well with experimental values for temperatures up to a few tenths of a degree below the λ temperature; the agreement becomes better with increasing pressure. Our theory contains only a single adjustable parameter, the roton hard–sphere radius, for which we find a value close to half the distance between nearest neighbors in the helium fluid. (auth)

1972 QUASI–ISOTHERMAL SUPERFLUID–FILM FLOW: OSCILLATIONS BETWEEN TWO RESERVOIRS. Hallock, R.B.; Flint, E.B. (Department of Physics and Astronomy, University of Massachusetts, Amherst, Massachusetts 01002). Phys. Rev. A 10: No. 4, 1285-1299 (Oct 1974).

We have carried out a detailed study of the frequency and damping of the oscillations in levels of two reservoirs of He II which are coupled only via the mobile superfluid film. Our experiments cover the temperature range $1.2 < T < 2.13$ K and utilize several geometries under quasi–isothermal conditions. Below 2 K our results for the damping are in quantitative agreement with predictions based on a theory first proposed by Robinson. This indicates that the damping mechanisms proposed by Allen and by Calvani, Greulich, and Maraviglia are of minor importance under our experimental conditions. It is argued that the Robinson theory can explain the previous general agreement with the Allen theory. (auth)

1973 NEW FACTORS AFFECTING THE MEASURED LIFETIME OF ELECTRONS TRAPPED ON VORTEX LINES IN He II. DeConde, K.; Williams, G.A.; Packard, R.E. (Department of Physics, University of California, Berkeley, California 94720). Phys. Rev. Lett. 33: No. 12, 683-685 (16 Sept 1974).

The lifetime of trapped electrons measured at $T < 1.5$ K is found to be affected by factors which should not influence the intrinsic ion–vortex–line interaction. Observations indicate that the vortex lines move in the container, and the trapped charge escapes when the vortex lines interact with the container wall. (auth)

1974 NUCLEAR MAGNETIC RESONANCE OF SUPERFLUID He^3 NEAR T_c IN HIGH MAGNETIC FIELDS. Osheroff, D.D.; Anderson, P.W. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. Lett. 33: No. 12, 686-689 (16 Sept 1974).

We present the first measurements of NMR behavior of superfluid He ^{3} in high magnetic fields at melting pressures in the A_1 region in which only one spin species has undergone pairing. We observe a linear shift in the square of the transverse resonant frequency in A_1 with a pressure dependence of $(9.52 \pm 0.19) \times 10^7$ (Hz)^2/mbar, which is 0.188 ± 0.004 times the low–field result. This and other features that we report are in detailed agreement with the theory presented. (auth)

1975 STRONG PHONON CONVERSION AT THE HELIUM–SOLID INTERFACE. Kinder, K.; Dietsche, W. (Institut für Feskörperforschung, Kernforschungsanlage Jülich, 517 Jülich, West Germany). Phys. Rev. Lett. 33: No. 10, 578-581 (2 Sept 1974).

Tunable monochromatic phonon pulses (130 to 870 GHz) were scattered at solid surfaces covered with various amounts of helium. A strong phonon loss due to only 3 atomic layers was observed which was independent of frequency and did not exhibit structure due to the helium dispersion. The results indicate strong frequency conversion at the interface, and thus suggest a new approach to the Kapitza–resistance problem. (auth)

1976 RAMAN SCATTERING IN SUPERFLUID HELIUM. Meyer, W. Los Angeles; Univ. of Southern California (1974). 283p. University Microfilms Order No. 74-21,489.

Thesis (Ph. D.).

Part of the work consisted of analyzing a microscopic model of liquid ^{4}He proposed by Wong and Huang. In their model they start out with an exact N-particle hard sphere pseudo-Hamiltonian in second quantization formulation. Keeping only the two body interaction terms, and restricting themselves to the pair terms in the momentum representation, Wong and Huang obtained a fairly good excitation spectrum. The hard sphere diameter "a" is the only parameter introduced. Contributions in this connection were: The calculation of the resulting pair correlation function, due to non-pair terms, the perturbation to the excitation spectrum due to an assumed attractive tail on top of the hard sphere interaction. Extraction of a roton-roton interaction from the initial Hamiltonian. Calculation of the resulting roton-roton collision frequency using the techniques proposed by Yau and Stephen and calculation of the density of states of interacting roton pairs of opposite momenta in the way first proposed by Ruvalds and Zawadowski. An estimate was also given of the genuine 3-body interaction terms neglected by Wong and Huang. Finally, an expansion parameter scheme suggested by Wong leading in a natural way to a Bogoliubov type Hamiltonian in the dilute case and a BCS-like Hamiltonian at realistic He densities was introduced. The second part then consisted in calculating the Raman Scattering spectrum of liquid ^{4}He based on above model and utilizing a semiclassical approach proposed by Hellwarth to express the interaction between the light and the liquid. (Diss. Abstr. Int., B)

1977 COLLISIONLESS SOUND AND STATIC MAGNETIZATION IN SUPERFLUID ^{3}He. Paulson, D. N. San Diego, CA; Univ. of California (1974). 134p. University Microfilms Order No. 74-22,205.

Thesis (Ph. D.).

The propagation of collisionless sound was studied at 5, 15, and 25 MHz at several pressures in the superfluid phases of liquid ^{3}He. The attenuation has a frequency dependent peak which appears below T_c, the line of second order transitions in heat capacity, and gradually goes to a frequency independent BCS-like behavior. The velocity drops at T_c and approaches the first sound velocity at the lowest temperatures. A temperature scale was developed from the line of second order transitions as a function of pressure and the attenuation of the collisionless sound in normal Fermi liquid ^{3}He. The static magnetization of superfluid ^{3}He was also studied for fields of 49, 60, 378, and 480 gauss. The line of first order transitions, T_{AB}, is positively identified for the first time by the associated jump in magnetization. A small increase in magnetization is seen when going from normal Fermi liquid to ^{3}He-A. The A phase is shown to have a temperature independent magnetization to less than a few tenths per cent. When going from ^{3}He-A to ^{3}He-B there is a drop in magnetization at T_{AB} which goes to zero as T_{AB} goes to T_c. The B phase magnetization decreases with decreasing temperature. For low magnetic fields a polycritical point is suggested at 21.5 bar and 2.41 mK. A profound effect of magnetic field on the phase diagram near the polycritical point is shown for fields as low as 60 gauss. The line T_{AB} moves to lower temperatures and pressures as the applied magnetic field increases. For a field of 378 gauss the A phase is interposed between the normal Fermi liquid and ^{3}He-B to the lowest pressure measured. The susceptibility of the B phase relative to the normal phase nuclear paramagnetic susceptibility is seen to be a nearly pressure independent function of T/T_c. ^{3}He-A and ^{3}He-B are explained as having the same T_c but a small difference in heat capacity and are therefore probably the same angular momentum state of BCS-like pairing states. (Diss. Abstr. Int., B)

Superconductivity

Refer also to abstracts 1167, 1209, 1220, 1240, and 1241.

1978 (AD-780459) INCOMPATIBILITY OF BCS PAIRING AND THE PEIERLS DISTORTION IN LINEAR CHAIN SYSTEMS. Final Report. Levin, K.; Mills, D. L.; Cunningham, S. L. (California Univ., Irvine (USA). Dept. of Physics). Nov 1973. Contract N00014-69-A-0200-9003. 14p. NTIS $3.00.

The coupled gap equations were solved for a one-dimensional electron gas which can undergo both a Peierls insulating and a BCS superconducting transition. It is found that, except for a very special case, (1) only one of the order parameters can be nonvanishing and (2) there is only one critical temperature. It is concluded that, independent of the pairing interaction strength, if the Peierls transition occurs, there can be no BCS superconductivity, and conversely. (auth)

1979 (NP-20182) SUPERCONDUCTING DEVICES AND MATERIALS. A Literature Survey Issued Quarterly, July–September 1973. Issue No. 73-3. Olien, N. A. (comp.). (National Bureau of Standards, Boulder, Colo. (USA). Inst. for Basic Standards). 1973. 77p. (COM-73-10665-03). NTIS $20 per yr, 4 issues.

This is a cooperative literature survey and review listing publications and reports pertaining to superconducting devices and to theory and experiment related to superconducting devices. (auth)

1980 STRUCTURE AND SUPERCONDUCTIVITY OF Ge_xCu_{1-x} ALLOY FILMS. Bahl, S. K.; Zehl, O. (Univ. of Maryland, College Park). Mater. Res. Bull.; 9: No. 10, 1313-1320(Oct 1974).

Structural studies of Ge_xCu_{1-x} alloy films show that for $x > 0.80$, 300°K deposited films are found to be amorphous. On in-situ heating these samples to ~100°C, discrete, crystalline, second-phase particles of Cu_3Ge (ϵ) compound appear in the amorphous matrix of Ge. For $x \leq 0.8$, crystallites of Cu_3Ge can be detected in amorphous Ge at room temperature. At higher Cu concentration ($x < 0.4$) in addition to crystalline Cu_3Ge and Ge, free copper is detected. These structural studies suggest that the superconductivity behavior observed in the quenched alloy films presumably arise from small crystallites of Cu_3Ge embedded in the amorphous matrix of Ge. (8 fig.) (auth)

1981 MEASUREMENT OF H_{c2} OF HIGH-FIELD SUPERCONDUCTORS BY RESISTANCE METHODS IN STRONGLY PULSED MAGNETIC FIELDS. Pan, V. M.; Popov, A. G. (Inst. of Metal Physics, Kiev). Metallofizika; No. 51, 109-112(1974). (In Russian).

The study of the upper critical field of high-field superconductors requires fields of the order of 300 to 500 kOe. An installation making it possible to obtain magnetic fields of this range in a volume necessary for placement of He cryostate pins and to use resistance methods for the determination of H_{c2} was described. The sensitivity of the measurement scheme (with consideration of the induction from the pulsed magnetic field) is of the order of 1 mOe. This makes it possible to determine the upper critical field for low density of the measurement current ($j \approx 2 \times 10$ A/cm^2) in fields close to 500 kOe. Oscillograms of the superconducting transition of Nb–50 at. % Ti were given for the cases of constant measurement current and variable current with frequencies of 25 and 150 kHz. (tr-auth)

1982 HARDENING OF SUPERCONDUCTORS. Haasen, P.; Freyhardt, H. C. (Goettingen Univ. (F.R. Germany). Inst. fuer Metallphysik). Umsch. Wiss. Tech.; 74: No. 14, 457(Jul 1974). (In German).

2 refs.

Type II superconductors are hardened by precipitate particles which pin magnetic flux lines and prevent them from moving under the action of an electrical current. (auth)

1983 EXPERIMENTAL TEST FOR THE CHARGE SUPERSELECTION RULE. Kershaw, D.; Woo, C.H. (University of Maryland, College Park, Maryland 20742). Phys. Rev. Lett. 33: No. 15, 918-921 (7 Oct 1974).

An experiment is suggested to test the existence of a phase correlation for two space–separated superconductors. The phase in question is that of the eigenvalue of the operator S that creates a pair in one superconductor and removes a pair from the other. This will also provide a clear–cut test for the charge and lepton number superselection rules. (auth)

1984 RESISTANCE OF A SUPERCONDUCTOR IN THE DYNAMIC MIXED STATE. Danilov, V. V.; Kupriyanov, M. Y.; Likharev, K. K. (M. V. Lomonosov Moscow State University). Sov. Phys.-Solid State (Engl. Transl.); 16: No. 3, 602-603(Sep 1974).

The effective resistance of a superconductor was calculated for arbitrary values of B/H_{c_2} with the Ginzburg–Landau parameter $\gg 1$ and at temperatures close to the critical temperature. (CES)

1985 INTERNAL FRICTION OF A SUPERCONDUCTOR IN A MAGNETIC FIELD. Miloshenko, V.E.; Postnikov, V.S.; Shunin, G.E. (Voronezh Polytechnical Institute). Sov. Phys.–Solid State 16: No. 3, 619-619 (Sept 1974).

The results of experimental and theoretical studies of the internal friction Q^{-1} of polycrystalline vanadium and vanadium single crystal superconductors as a function of the external magnetic field are reported, and a possible mechanism for the appearance of the peak in Q^{-1} of a superconductor at the normal-superconducting transition is discussed. (CES)

1986 SIZE EFFECT OF ENHANCED SUPERCONDUCTING TRANSITION TEMPERATURE IN THIN FILMS. Antonyuk, B.P. (Institute of Spectroscopy, Academy of Sciences of the USSR, Akademgorodok, Moscow Region). Sov. Phys.—Solid State 16: No. 2, 395-395 (Aug 1974).

The effect of reduced screening and phase—space volume on T_c is considered for the example of a monomolecular metallic layer for which the Fourier component of the screened Coulomb potential $V_2(k)$ is found. (CES)

1987 PHOTOINDUCED SUPERCONDUCTIVITY IN CRYSTALS WITH A PAIR OF MIRROR—IMAGE BANDS. Kovarskii, V.A.; Golub, A.A. (Institute of Applied Physics, Academy of Sciences of the Moldavian SSR, Kishinev). Sov. Phys.—Solid State 16: No. 2, 405-406 (Aug 1974).

It is shown that because of the negative effective mass of an electron in the state C_2, the energy spectrum of the system has discrete levels above the top of the band C_2. High-power optical pumping of these levels may produce a charged superfluid Bose gas. (CES)

1988 LOW—FREQUENCY INTERNAL FRICTION IN SUPERCONDUCTORS. Natsik, V.D. (Physicotechnical Institute of Low Temperatures, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.—Solid State 16: No. 2, 334-336 (Aug 1974).

Theory is derived for the absorption of low—frequency elastic oscillations in superconductors with dislocations. The absorption mechanism is the fluctuational separation of dislocations from impurities. The influence of quantum fluctuations and the electron viscosity on the separation process is taken into account. Because of the rapid decrease in the electronic—friction force of dislocations at the superconducting transition the average separation frequency is a nonmonotonic function of the temperature. Accordingly, there can be two peaks on the temperature dependence of the internal friction. It is also shown that the absorption in the superconducting state can be either more or less pronounced than that in the normal state, depending on the relations between the structural parameters of the crystal and the oscillation frequency. (auth)

1989 UPPER CRITICAL FIELD H_{c2} OF MANY—BAND SUPERCONDUCTORS. Masharov, N.F. (All—Union Scientific Research Institute of Physicotechnical and Radio—Engineering Measurements, Mendeleevo). Sov. Phys.—Solid State 16: No. 3, 490-491 (Sept 1974).

An analysis is made of the effect of many bands on the critical magnetic field H_{c2}. It is shown, first on the example of a two—band weak—coupling superconductor at zero temperature and then for a more general form of electron interaction of any temperature, that interband transitions increase H_{c2}. (auth)

1990 SUPERCONDUCTIVITY OF METALS. Kumar, M. K. (Indian Inst. of Tech., Bombay). Met. Eng.—IIT (Indian Inst. Technol.) Bombay; 2: 37-43(Mar 1971).

The discovery and development of superconductivity in metals are reported. Meissner effect in superconductors is explained and the dependence of the phase transition from a normal to a superconducting state on the critical magnetic field H_c is pointed out. Type I and type II superconductors are explained. It is demonstrated that the transitions between the normal and superconducting states is thermodynamically reversible. The main feature noted is that monovalent metals, ferro and antiferromagnetic materials are not superconductors. It is also noted that superconducting metals are not good conductors at normal temperature. Superconductivity is favoured when the valence electrons per atom are 3, 5 and 7. The quantum theory of superconductivity (BCS theory) is explained. The metallurgical aspects of this phenomenon in metals are discussed. The problems in attaining low temperatures required for superconductivity are indicated. Superconductors are finding applications in the production of high strength magnets, in lossless transmission of electrical power, in computers as logic elements, in the detection of infrared radiation and in the construction of frictionless bearings. A list of superconducting elements with the corresponding critical temperatures is presented. (INIS)

1991 FLUCTUATION EFFECTS IN THE SUPERCONDUCTING TRANSITION OF RHENIUM. Schreiber, R. Houston, TX; Rice Univ. (1974). 112p. University Microfilms Order No. 74-21,327. Thesis (Ph. D.).

The diamagnetic behavior of a superconductor in a weak magnetic field has been investigated above and below T_c, and in the transition region. Five zone refined rhenium single crystals with varying annealing histories have been studied and found to have a transition temperature of $T_c(0) = 1.697 \pm .003$ K. The ratios of the electronic mean free path l to the zero temperature coherence length $\xi(0)$ range from $l/\xi(0) = 2.0$ to 3.3 while the resistivity ratios range from $\rho_{300}/\rho_{4.2} = 3500$ to 5500. The dependence of the transition width on the annealing history was studied, and a width of 7×10^{-6}K was found for the best annealed sample. The transition width was found to be also dependent on the field strength which is attributed to thermal fluctuations in the superconducting order parameter. Above T_c the small diamagnetic susceptibility was measured and its temperature dependence was found to agree with theoretical predictions for the case of small magnetic fields. Below T_c the isothermal superconducting magnetization curves were measured at temperatures such that ,3 Oe > H_c > ~5 mOe. For critical fields larger than ~50 mOe the thermodynamic critical field curve has a slope of $|dH_c/dT|T_c = 220$ Oe/K ± 5%. This slope yields the coefficient of the normal state electronic specific heat $\gamma = 2.2$ mJ mole^{-1} K^{-2} and the energy gap at T = 0: $2\Delta(0) = 3.70k_BT_c$. For temperatures where H_c is less than ~50 mOe the slope of the thermodynamic critical field curve was found to decrease continuously for all samples to about 40 Oe/K at a critical field of ~5 mOe. A simple point defect model is introduced to interpret these results, and it is found that the observed changes are due to the superposition of effects due to sample inhomogeneities and thermal fluctuations of the superconducting order parameter. (Diss. Abstr. Int., B)

1992 PHYSICAL PROPERTIES AND ELECTRON STRUCTURE OF SUPERCONDUCTING COMPOUND WITH THE STRUCTURE OF BETA-TUNGSTEN. Izyumov, Yu. A.; Kurmaev, E. Z. (Inst. of Metal Physics, Sverdlovsk, USSR). Usp. Fiz. Nauk; 113: No. 2, 193-238(Jun 1974). (In Russian).

A review is presented on the physical properties and theoretical models of transition metal compounds with an A-15 structure (of β-tungsten). Consideration is given not only to binary compounds of stoichiometric composition, but also to their numerous alloys with each other. Discussions are presented on the electronic heat capacity, magnetic susceptibility, the Knight shift and other electronic properties as a function of composition and temperature. A comparison of these results with optical and x ray spectra is presented. Detailed studies are carried out on anomalies of lattice modules in V_3Si and Nb_3Sn, and the nature of the martensitic transformations in these compounds are analyzed. Particularly detailed studies are carried out on the superconducting transition temperature both for the pure compounds and also for their alloys as a function of composition, stoichiometry, electron concentration and pressure. A presentation is made of the existing theoretical models of the electronic structure of these compounds, and the predictions of electronic and lattice properties derived from these models are compared with experimental data. It is shown that none of the existing models can explain the whole complex of observed phenomena. The direction of further experimental studies is indicated. 3 tables, 22 illustrations, 128 references. (SJR)

PHYSICS (NUCLEAR)

1993 (PB-232319) REPORT OF NRL PROGRESS. (Naval Research Lab., Washington, D. C. (USA)). Nov 1973. 90p. NTIS $4.00.

Research programs of 1973 are described. These include: environmental quality, acoustics, electronics, metallurgy, nuclear physics, ocean sciences, ocean technology, radar, and solid state physics. (GRA)

Neutron Interactions with Matter

Refer also to abstracts 2172 and 2195.

1994 (EURFNR-1202) METHOD TO INVESTIGATE NEUTRON INELASTIC CROSS SECTION DATA BY ANALYZING FAST NANOSECOND DECAYING SPECTRA. Pieroni, N. (Kernforschungszentrum Karlsruhe (F. R. Germany)). May 1974. 54p. (KFK-1968). Dep. NTIS (US Sales Only) $5.45.

Work performed under United States–Euratom Fast Reactor Exchange Program.

A method to test and improve neutron inelastic scattering cross section data of reactor materials was developed. It is based on the great sensitivity of fast nanosecond decay leakage spectra of small pulsed systems to the inelastic scattering process. By analyzing the decaying spectra in small energy intervals, quantitative changes in the inelastic cross section data can be introduced to provide agreement between calculation and measurement. In this manner adjusted data can be defined. The method required the use of a reliable spectrometric procedure to measure fast nanosecond time-dependent spectra and an appropriate time-dependent spectra computational procedure. A NE 213 liquid scintillator detector was used in the measurements. The Karlsruhe Monte-Carlo program KAMCCO was adapted for the calculations performed in this study. The method was applied to the study of an iron and a natural uranium system. It was possible to define adjusted inelastic cross section data for iron and ^{238}U. The reliability of the information obtained by the present method was verified through independent experiments. (20 figures, 7 tables) (auth)

1995 (WAPD-TM-1182) MEASUREMENTS AND CALCULATIONS OF HEAVY ISOTOPES IN IRRADIATED FUELS AND OF ^{233}U FISSION-PRODUCT POISONING (LWBR DEVELOPMENT PROGRAM). Gunst, S. B.; Connor, J. C.; Conway, D. E. (Bettis Atomic Power Lab., Pittsburgh, Pa. (USA)). Jul 1974. Contract AT(36-1)-GEN-14. 292p. Dep. NTIS $17.75.

Samples of ^{233}U, natural uranium, ^{238}U, and natural thorium have been irradiated in high-flux facilities in different neutron spectra and for different durations including exposures to more than 90% depletion in fissile material and more than 30,000 MWd/tonne in fertile material. End-of-life mass analyses generally agree with calculated concentrations based on measured exposure histories within a few percent for the total and isotopic uranium, total and isotopic plutonium, ^{137}Cs, and neodymium isotopes. For ^{233}U, reactivity measurements between irradiation cycles provide experimental results for the fissile content and fission-product poisoning as functions of both irradiation and cooling time. Corresponding results obtained from calculated concentrations agree with measurements to about 1% for the fissile content and 3% for the effective one-group fission-product poison cross section, but thermal and epithermal barns per fission exhibit differences between measurement and calculation that are believed to be attributable to inadequate data in the literature on important fission products. Experimental results for transient absorbers in irradiated ^{233}U give at least 20,000 b for the capture resonance integral of ^{149}Pm, a factor of 15 higher than that obtained from the thermal cross section by 1/v extrapolation. For ^{135}Xe, the absorption is 9% higher than calculated using ENDF/B Version III data. Information is also provided concerning such matters as fuel losses upon the chemical dissolution of highly irradiated fertile fuel (natural uranium), the production of plutonium isotopes ^{238}Pu through ^{242}Pu in irradiated natural uranium, yields and/or cross sections of neodymium nuclides, conversion ratios in irradiated fertile fuels, the existence of significant transient fission-product poisons other than ^{135}Xe and ^{149}Sm, and the shielding of ^{233}U by ^{232}Th with implications suggesting a possible change in the energy dependence of the ^{232}Th thermal cross section. (auth)

1996 ADJOINING APPROPRIATE SINGULAR ELEMENTS TO TRANSPORT THEORY COMPUTATIONS. Abu-Shumays, I. K.; Bareiss, E. H. (Northwestern Univ., Evanston, IL). J. Math. Anal. Appl.; 48: No. 1, 200-222(Oct 1974).

The usefulness of singular finite elements to achieve greater accuracy near material discontinuities in one-dimensional (slab geometry) transport theory computations is explored. For simplicity, the treatment is restricted to one energy group stationary transport with isotropic scattering, and the units of length and time are chosen such that the neutron speed is one and the mean free path is one. (JFP)

1997 THERMAL NEUTRON SPECTROSCOPY WITH STATISTICAL PULSED BEAM. Borca, E. (Univ., Bucharest). Stud. Cercet. Fiz.; 25: No. 9, 1075-1085(1973). (In Rumanian).

The physical principles of spectroscopy of pseudo-statistical pulsed thermal neutron beam and specifical advantages of this method are presented. There are mentioned some experimental ways of carrying out this spectroscopy with mechanical and magnetic correlation, too. (auth)

1998 NEW PROCEDURE FOR THE DETERMINATION OF NEUTRON MULTIGROUP TRANSFER MATRICES. Weisbin, C. R. (Oak Ridge National Lab., TN); Soran, P. D.; Hendricks, J. S. Nucl. Sci. Eng.; 55: No. 3, 329-341(Nov 1974).

A new technique was employed to generate Legendre components of group-to-group neutron scattering cross-section matrices for two-body interactions. This semianalytic procedure, which treats the rapidly fluctuating cross-section behavior analytically, was incorporated in the MINX processor, a code for the Multigroup Interpretation of Nuclear X-sections. The algorithm requires only a minimum of numerical approximations and uses recursive formulas well suited to performing the required integrations. A flexible energy integration mesh is employed so that localized resonance phenomena may be adequately represented. (3 tables) (auth)

1999 MEASUREMENTS AND CALCULATIONS OF THE NEUTRON SPECTRA EMITTED FROM CONCRETE SPHERES BOMBARDED WITH 14-MeV NEUTRONS. Hansen, L. F. (Lawrence Livermore Lab., CA); Anderson, J. D.; Doyas, R. J.; Howerton, R. J.; Komoto, T.; Logan, C. M.; Wong, C.; Kammerdiener, J. L. Nucl. Sci. Eng.; 55: No. 3, 345-348(Nov 1974).

The neutron spectra emitted from 2 and 4 mean free paths of concrete irradiated by 14-MeV neutrons were measured between 14 and 2 MeV by using the sphere transmission and time-of-flight techniques. The spectra were calculated with the Monte Carlo neutron transport code TART by use of the ENDL Livermore neutron library and the ENDF/B-III neutron library. From the comparison between measurements and calculations, it was inferred that the nonelastic cross section for oxygen in the ENDL library was too large. A revision of the cross sections for 14- and 14.6-MeV neutrons was carried out and resulted in very good agreement between measurements and calculations. (3 figures, 3 tables) (auth)

2000 SOLUTION OF TWO-DIMENSIONAL DIFFUSION EQUATION BY THE FINITE FOURIER TRANSFORMATION. Kobayashi, K.; Ohtani, N.; Jung, J. (Kyoto Univ.). Nucl. Sci. Eng.; 55: No. 3, 320-328(Nov 1974).

A two-dimensional diffusion equation is solved by using the finite Fourier transformation. Through applying the Fourier transformation, a one-dimensional Fredholm-type integral equation of the first kind is derived for the flux and its derivative at the boundary. By solving this equation with given boundary conditions, all of the boundary values are determined. The fluxes inside a region are also obtained by solving similar integral equations. The method differs from the usual Fourier transformation method in that the solutions are obtained without performing the inverse Fourier transforms. Numerical calculations show that the present method gives higher accuracy with less computation time than the usual finite difference method. (1 table) (auth)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 1445, 1726, 1928, 1932, 1934, 1955, 2036, and 2198.

2001 (ORO-4043-21) EXPERIMENTS ON THE NUCLEAR INTERACTIONS OF PIONS. Progress Report, September 1, 1973–May 31, 1974. McCarthy, J. S.; Minehart, R. C.; Sobottka, S. E.; Ziock, K. O. H. (Virginia Univ., Charlottesville (USA)). 1974. Contract AT(40-1)-4043. 34p. Dep. NTIS $4.75.

The data on π^- capture in ^{3}He resulted in a new determination of the branching ratio $\pi^- + {}^3\text{He} \to n + d$. A search was made for effects of a solid state phase transition on the relative capture rates from different levels of muonic atoms. No effects of more than 2 standard deviations were present. The analysis of the Berkeley (π^+, 2p) experiment was completed and a paper written. The data on π^- elastic scattering in calcium were analyzed and fit with optical model parameters. A paper was prepared. The analysis of data taken at the Space Radiation Effects Laboratory on elastic scattering of π^- from ^{3}He and ^{4}He at energies from 180 to 220 MeV was begun. Some old data from electron-deuteron scattering were analyzed to extract a neutron charge radius that is consistent with that obtained from thermal neutron scattering. The results are inconsistent with constituent models of the neutron where the elementary particles obey SU(3) or SU(6) symmetry. The small distance behavior of the helium wave functions was obtained by reanalysis of electron scattering data. The short-range repulsion in nuclear systems is clearly demonstrated by a large depression in the density at a radius ≤ 0.8 fm. The development of proportional chambers with helical delay line cathodes and associated electronics was continued. For testing of EPICS a special chamber sensitive to α particles was developed. A contribution was made to the assembly of EPICS, and to the measurement and analysis of magnet fields for the spectrometer as well as to the performance tests of the LEPC. Feasibility studies for a high intensity synchrotron of 8-10 GeV using LAMPF as the injector point to the special problems of such a machine and indicate some possible solutions. The development of apparatus and computer programs for the π-d elastic scattering experiment is complete and the experiment is being mounted in the P^3 beam. The development of the apparatus for the detection and identification of heavy fragments is complete, and the experiment is ready for mounting in the biomedical channel. (auth)

2002 (ZFK-269) NUCLEON–NUCLEON SCATTERING LENGTHS FROM THE REACTIONS ^{3}He(d,pt)p AND ^{3}He(d,pτ)n. Kuehn, F.; Moesner, J.; Schmidt, G.; Stiehler, T. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Mar 1974. 13p. Dep. NTIS (US Sales Only) $4.00.

Coincidence spectra were measured for the reactions ^{3}He(d,pt)p and ^{3}He(d,pτ)n at $E_d = 13.9$ MeV, $\Theta_p = 71.9°$ and $\Theta_{t,\tau} = 31°$. The Migdal–Watson approximation was used to extract the scattering lengths $a_{pp} = -7.2 \pm 1.3$ fm and $a_{np} = -26.2 \pm 3.3$ fm. Under the kinematical conditions used in the present experiment, the Migdal–Watson theory turns out to be suitable to extract nucleon–nucleon scattering parameters from these three-body reactions. (8 figures) (auth)

2003 MEASUREMENTS OF FINE STRUCTURES IN EXCITED STATES OF ^{4}He$^+$ BY FAST-BEAM RADIO-FREQUENCY RESONANCE. Churassy, S. (Laboratoire de Spectrometrie Ionique et Moleculaire, Villeurbanne, France); Gaillard, M. L.; Silver, J. D. Phys. Rev. Lett.; 33: No. 4, 185-187(22 Jul 1974).

Measurements of s-p, f-g, and g-h transitions in electronically excited states of ^{4}He$^+$ observed via electric dipole resonances on a fast helium ion beam. (auth)

2004 FORMALISM FOR THE $T(\vec{d},\vec{n})^4$He AND ^{3}He$(\vec{d},\vec{p})^4$He REACTIONS. Keaton, P. W. Jr.; Gammel, J. L.; Ohlsen, G. G. (Los Alamos Scientific Lab., NM). Ann. Phys. (N. Y.); 85: No. 1, 152-213(30 May 1974).

The formalism required to describe the $T(\vec{d},\vec{n})^4$He or ^{3}He$(\vec{d},\vec{p})^4$He reaction when all particles may be polarized is discussed. The relation among the various sets of spin-1 tensors is stated explicitly, so that the formulas applying to a particular experiment may be written easily in terms of any desired system. (auth)

2005 STRUCTURE OF ^{3}He AND ^{4}He NUCLEI. Vinciguerra, D. (Univ., Catania, Italy). Lett. Nuovo Cim.; 10: No. 18, 799-803(31 Aug 1974).

A simple model of the He nuclei is suggested, which implies the existence of the nucleon-nucleon correlations. The hypothesis is made that the total effect of the nuclear forces in a nuclear system like ^{3}He or ^{4}He is such that the i-th nucleon moves in the space around a position R_i away from the nuclear center of mass. The model is successful in describing the charge form factor and the proton binding energy of ^{3}He and ^{4}He. (LBS)

2006 PROTON–HELIUM TOTAL REACTION CROSS SECTIONS BETWEEN 18 AND 48 MeV. Sourkes, A. M.; Davison, N. E.; Elbakr, S. A.; Horton, J. L.; Houdayer, A.; Oers, W. T. H. van (Manitoba Univ., Winnipeg (Canada). Dept. of Physics); Carlson, R. F. (Redlands Univ., Calif., USA. Dept. of Physics). Phys. Lett., B; 51: No. 3, 232-234(5 Aug 1974).

Proton total reaction cross sections for ^{3}He and ^{4}He have been measured in the energy range 18 to 48 MeV at ten and sixteen energies, respectively. Comparison is made with other experimental nucleon-induced reaction information. Comparing the p–^{4}He measurements with phase shift analyses, resonating-group calculations, and optical model predictions points to improvement for the model-dependent theoretical work. (auth)

2007 DEUTERON ELECTRODISINTEGRATION AND THE NUCLEON AXIAL VECTOR FORM FACTOR. Lock, J. A.; Foldy, L. L. (Case Western Reserve Univ., Cleveland, Ohio (USA)). Phys. Lett., B; 51: No. 3, 212-216(5 Aug 1974).

Calculated deuteron electrodisintegration cross sections by back-scattered electrons give the major contributions at momentum transfer squares above 6 fm^{-2} as arising from the catastrophic process, which in PCAC-current algebra theories is proportional to the axial vector form factor. Experimental data are reasonably fitted by $F_A(\Delta^2) = (1 + \Delta^2/m_A^2)^{-2}$ with $m_A = 0.81$ GeV. (auth)

2008 THREE BODY CLUSTERS IN FINITE NUCLEI. I. ^{4}He. Woodring, J. W.; MacKellar, A. D.; Tripathi, R. K. (Kentucky Univ., Lexington (USA)). Nucl. Phys., A; 228: No. 2, 345-355 (12 Aug 1974).

A method is developed for the treatment of the Bethe–Faddeev three-body cluster equations in finite nuclei. A matrix method is employed to sum the three hole line graphs in ^{4}He. For each value of a constant shift C in the intermediate state oscillator spectrum the authors have calculated: (i) the two-body bound state binding energy self-consistently in the Brueckner approximation, (ii) the energy contribution from three hole line graphs, and (iii) the effect of single-particle potential insertion in particle lines. The most important dependence on C comes from those graphs containing single-particle insertions, and their effect is to make the sum of (i) + (ii) + (iii) much less dependent upon C than (i) alone. The three hole line contribution for ^{4}He comes mainly from third-order graphs. Effects of truncation of the matrix are severe, and calculations with a larger matrix could alter the quantitative but probably not the qualitative results. (auth)

2009 A NEW ANALYSIS OF ANGULAR DISTRIBUTIONS ATTRIBUTED TO THE NEUTRON–PROTON FINAL STATE INTERACTION IN THE REACTION pd → ppn. Kluge, W.; Schleufter, R. (Karlsruhe Univ. (TH) (F.R. Germany). Inst. fuer Experimentelle Kernphysik); Ebenhoeh, W. (Heidelberg Univ. (F.R. Germany). Inst. fuer Theoretische Physik). Nucl. Phys., A; 228: No. 1, 29-38(5 Aug 1974).

Recently measured angular distributions attributed to the neutron–proton final-state interaction at zero relative energy in the reaction pd → ppn are analyzed with an exact three-body theory using spin-dependent separable potentials for relative S-states of two nucleons. The relation between the Watson factorization ansatz and the exact theory is demonstrated for the case of the angular distribution measured with an incident beam of 52-MeV deuterons. (auth)

2010 POTENTIAL EFFECTS IN NUCLEON–DEUTERON SCATTERING. Bruinsma, J.; Ebenhoeh, W.; Stuivenberg, J. H.; van Wageningen, R. (Vrije Universiteit, Amsterdam (Netherlands). Natuurkundig Lab.). Nucl. Phys., A; 228: No. 1, 52-76 (5 Aug 1974).

Nucleon–deuteron elastic scattering and break-up cross sections have been calculated using many different S-wave rank-one separable potentials. A correlation between the different results and the intrinsic strength of the interaction has been found. A proper treatment of the high-energy repulsion improves agreement with experiments. The Coulomb interaction has been included in an approximate way. (auth)

2011 PARITY NON-CONSERVING EFFECTS IN THE REACTION $n + {}^2\text{H} \to {}^3\text{H} + \gamma$. Hadjimichael, E.; Harms, E.; Newton, V. (Fairfield Univ., Conn. (USA)). Nucl. Phys., A; 228: No. 1, 1-14 (5 Aug 1974).

The circular polarization and the asymmetry in the distribution of outgoing photons have been calculated in the reaction $n + {}^2\text{H} \to {}^3\text{H} + \gamma$ for thermal incident neutrons. These effects become possible because of an admixture of odd-parity states in the three-body system by means of the weak, parity non-conserving component of the N–N interaction. Several theoretical models have been investigated for this interaction, and it is found that the parity non-conserving effects are generally of order 10^{-6}. With the exception of potentials derived on the basis of SU(6) considerations, the results do not show remarkable sensitivity to different models. (auth)

2012 COULOMB ENERGY OF He^3 AND CHARGE SYMMETRY OF NUCLEAR FORCES. Mehdi, S.S. (Department of Physics and Astrophysics, University of Delhi, India); Gupta, V.K. Phys. Rev. Lett. 33: No. 12, 709-711 (16 Sept 1974).

The Coulomb energy of He^3 has been calculated using separable potentials with a repulsive term. The calculated value is in close

agreement with the H^3-He^3 binding-energy difference. An expected 3-6% decrease, brought about mainly by the inclusion of a tensor term, can be explained by charge asymmetry due to $n-\pi$ and $p-\omega-\varphi$ mixing, provided one takes $g_o/g_v > 0$. This also yields $a_{nn}-a_{pp} \lesssim 0$, which is required by the present experimental situation, in contrast to $a_{nn}-a_{pp} \sim 1.4$ fm obtained by earlier authors with $g_o/g_v < 0$. (auth)

2013 NUCLEON-NUCLEON INTERACTION AND THE NUCLEAR PROBLEM OF THREE BODIES. II. Akhmadkhodzhaev, B.; Zubarev, A. L. (Tashkent State Univ.). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 3, 71-75(1974). (In Russian).

Realistic potentials in the nuclear problem of three bodies are considered. These potentials take into account repulsion at small distances. If the potentials do not contain repulsion, there is a strong dependence of the binding energy of tritium and of the doublet length of nd-scattering on the form of the potential and on the singlet radius. It is shown that three-particle forces (binding energy of the triton and doublet length of nd-scattering) depend only slightly on the form of the realistic potential. A model with forces outside the central mass is constructed, in which it is possible to obtain agreement with experimental results. (SJR)

2014 MEASUREMENTS OF NEUTRON POLARIZATION ANGULAR DISTRIBUTIONS FOR THE REACTIONS $^1H(\vec{n},n)^1H$ AND $^2H(\vec{n},n)^2H$ AT 17 AND 21 MeV. Morris, C. L. Charlottesville, VA; Univ. of Virginia (1974). 57p. University Microfilms Order No. 74-23,243.

Thesis (Ph. D.).

Using the $^3H(d,\vec{n})^4He$ reaction as a source of polarized neutrons, polarization asymmetries were measured for n-p and n-d elastic scattering at 17 and 22 MeV. The n-p polarization are compared with previously reported measurements at nearby energies, and with the LRL-X and YALE-IV phase shift predictions. Neither phase shift set can be shown to be favored. The most notable feature of the n-d polarization measurements is their good agreement with p-d results, in contradiction with previously reported results at 22.7 MeV. Recent theoretical work is shown to agree well with the shape of the polarization angular distribution, but to disagree in magnitude. (Diss. Abstr. Int., B)

2015 THREE BODY CLUSTER EFFECTS IN ^4He. Woodring, J. W. Lexington, KY; Univ. of Kentucky (1973). 75p. University Microfilms Order No. 74-21,081.

Thesis (Ph. D.).

A method of solving the Bethe-Faddeev three-body cluster equations which is applicable, in principle, to all doubly closed shell nuclei was developed. Calculations for ^4He were carried out using reaction matrix elements of the Yale nucleon-nucleon potential. The work of Bethe and Rajaraman in nuclear matter suggests that the three hole line ladder graphs in the Brueckner-Goldstone perturbation expansion should be summed to all orders in a finite nuclear system to test the series convergence. A matrix operator which expresses the sum of all three hole line graphs in evaluated in a basis set of harmonic oscillator functions, the energies of which were shifted by an amount C. The occupied states were shifted by an additional amount η, which is chosen so that approximate self-consistency is achieved for each value of C. The contribution to the total nuclear binding energy of the three-body cluster graphs, $E^{(3)}$, is calculated at six values of C between zero and fifty MeV. Contributions from third order graphs and from graphs of all higher orders are calculated separately. The contribution from graphs of order greater than three is found to be negligibly small, while the third order graphs contribute about .25 MeV/nucleon of binding energy. This indicates that for ^4He the perturbation series converges order by order, most likely due to the large interlevel spacing of ~20 MeV required. It is found that when single particle potential insertions are included with the third order graph, $E^{(3)}$ exhibits the type of functional dependence on C which is required for convergence (i.e., $E^{(3)}$ increases with increasing C while $E^{(1)}$, the Brueckner approximation, decreases with increasing C). A method of including potential insertions to all orders is developed. This method is shown to be equivalent to that of Baranger, but computationally more straightforward for use in single oscillator configuration calculations. (Diss. Abstr. Int., B)

2016 TWO- AND THREE-BODY CORRELATIONS IN THE PHOTONUCLEAR DIPOLE SUM. Fink, M. (Gymnasium Bismarckstrasse, Hattingen, Germany); Garl, M.; Hebach, H.; Zabolitzky, J. G. (Bochum Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Phys. Lett., B; 51: No. 4, 320-324(19 Aug 1974).

The enhancement factor κ in the photonuclear dipole sum rule is calculated using Brueckner-Hartree-Fock (BHF) wave functions, i.e. accurate solutions of the coupled Bethe-Goldstone- and Hartree-Fock equations with approximate inclusion of the three-body Bethe-Faddeev amplitudes. The effect of these two- and three-body correlations is discussed in dependence of various nucleon-nucleon potentials. Results are presented for ^4He and ^{16}O. (auth)

2017 ANALYSIS OF LARGE ANGLE p-d ELASTIC SCATTERING: 100-400 MeV. Nasser, M. A.; Igo, G. J. (California Univ., Los Angeles (USA). Dept. of Physics); Perez-Mendez, V. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nucl. Phys., A; 229: No. 1, 113-132(26 Aug 1974).

An analysis is presented of large-angle proton-deuteron elastic scattering experiments at deuteron energies of 291, 362 and 433 MeV proton energies of 140 and 316 MeV on the basis of the Kerman-Kisslinger (KK) model (first order). Further analysis is made using the KK model with second-order corrections included. The object of the analysis is to determine quantitatively the sensitivity of large-angle scattering to the D-state probability (P_D) in the deuteron. It is found that the KK model (first-order and second-order corrections included) is not very successful in fitting the data at those energies when used with existing wave functions obtained from phenomenological potentials. A value of 6.7% for P_D gives the best fit when the model is used with the modified Moravcsik analytic fit to the Gartenhaus S-state wave function (the third approximation). The incoherent contributions of first- and second-order non-exchange processes are roughly estimated and found to be negligible. An investigation of the ambiguities in the S-state part of the deuteron wave function is also presented. (auth)

2018 DIRECT APPROACH TO THREE NUCLEON BOUND STATE PROBLEMS WITH REALISTIC POTENTIALS. Bassett, I. M.; Lederer, B. R. E.; Vorlicek, G. C. (Sydney Univ. (Australia). School of Physics). Phys. Lett., B; 51: No. 4, 329-330 (19 Aug 1974).

A direct numerical approach to the solution of three nucleon bound state problems with realistic potentials is described, and the results of an application to a three nucleon problem with two particle central and tensor forces including a hard core are given. The feasibility of the method in problems of this nature is demonstrated. (auth)

2019 AN APPLICATION OF THE MULTICHANNEL CLUSTER MODEL THEORY TO THE ELASTIC PROTON-α SCATTERING. Hackenbroich, H. H.; Heiss, P.; Le Chi Niem (Koeln Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Phys. Lett., B; 51: No. 4, 334-336(19 Aug 1974).

In the framework of the cluster model reaction theory a calculation for the elastic α-p scattering below 30 MeV was performed. The nucleon-nucleon potential, which contains spin orbit and tensor forces, has been successfully used in reaction calculations for other light nuclei. The calculated α-p cross section and polarization values are in quantitative agreement with experimental data. (auth)

2020 ^5He RESONANT STATES IN THE CLUSTER MODEL. Leclercq-Willain, Ch.; Libert-Heinemann, M. (Brussels Univ. (Belgium)). Nucl. Phys., A; 229: No. 1, 15-28(26 Aug 1974).

A microscopic calculation of the energies of some ^5He resonances is performed in the framework of the cluster model. Trial wave functions with definite eigenvalues of parity and orbital angular momentum L or total angular momentum J have been tested with some usual phenomenological nucleon-nucleon interactions. (auth)

2021 DOUBLE-CHARGE-EXCHANGE AND INELASTIC SCATTERING IN $\pi^- + {}^3He$. Sperinde, J.; Fredrickson, D.; Perez-Mendez, V. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nucl. Phys., B; 78: No. 2, 345-369(25 Aug 1974).

The reactions $\pi^- + {}^3He \rightarrow \pi^+ + 3n$ and $\pi^- + {}^3He \rightarrow \pi^- + {}^3He^*$ were studied to investigate the $T = 3/2$ three-nucleon system. The differential cross sections were measured at scattering angles from 20 to 40 degrees. The secondary pion was momentum analyzed in a magnetostrictive-readout wire-chamber spectrometer. The double-charge-exchange reaction yielded a secondary pion energy distribution, the features of which can be due to either a $T = 3/2$ three nucleon resonance or a resonance of the nucleons in the ^3He nucleus. The inelastic scattering reaction yielded a secondary pion energy distribution peaked near threshold, consistent with resonances in both the $T = 3/2$ and $T = 1/2$ three-nucleon systems. (auth)

Nuclear Properties and Reactions, $6 \leq A \leq 19$

Refer also to abstracts 1719, 1728, 1914, 1999, 2016, 2058, 2065, 2069, 2114, 2191, 2198, and 2216.

2022 (KHFTI-73-10, pp 20-23) NUCLEI YIELDS AT CARBON, OXYGEN, AND ALUMINIUM BOMBARDMENT WITH PROTONS AT 1 GeV. Batist, L. Kh.; Berlovich, E. E.; Blinnikov, Yu. S.; Elkin, Yu. V.; Novikov, Yu. N.; Ovchinnikov, B. M.; Tarasov, V. K. (Inst. of Nuclear Physics, Leningrad). 1973. (In Russian).

The yields of the radioactive nuclei ^{11}Be, ^{14,15,20}O, ^{20}F, ^{23,24}Ne, and ^{25}Na, formed during bombardment of targets of C, O_2, and Al by 1-GeV protons were measured by the registration of the γ lines. (tr-auth)

2023 NUCLEAR γ-RAY PRODUCTION IN P–NUCLEUS INTERACTIONS AT HIGH ENERGY. Alard, J. P. (Univ. de Clermont, Aubiere, France); Baldit, A.; Costilhes, J. P.; Fargeix, J.; Roche, G.; Tamain, J. C.; Cassagnou, Y.; Bonnardeau, M.; Faessler, M.; Riter, M. Lett. Nuovo Cim.; 10: No. 18, 841-844(31 Aug 1974).

It is pointed out that the observation of γ-rays produced in the interaction of galactic cosmic rays or solar fast particles with the interstellar matter should yield interesting information about the nature and the localization of probable cosmic-ray sources, because γ-rays are insensitive to galactic magnetic fields. The first results of an X(p,γ) experiment at 1.65 GeV/c using carbon and water targets are reported. Measurements of the γ-spectra and cross sections are presented. (LBS)

2024 THE SEQUENTIAL DECAY ^{10}B(α,α)^{10}B*(α)^{6}Li AT E_α = 24 MeV. Stehle, H.; Eichner, H.; Helten, H. J.; Klein, H.; Kretzer, H.; Prescher, K.; Wohlfarth, W. W. (Koeln Univ. (F.R. Germany). Inst. fuer Kernphysik). Nucl. Phys., A; 228: No. 2, 229-245 (12 Aug 1974).

In the break-up reaction ^{10}B(α,2α)^{6}Li at E_α = 24 MeV, the sequential decay via excited levels of ^{10}B is found to be the dominant mechanism. Expected contributions of $\alpha-\alpha$ quasifree scattering and sequential decay via ^{8}Be levels are negligible. The kinematically complete, coplanar $\alpha-\alpha$ coincidence measurements at various angle combinations could not be analyzed consistently without postulating 17 new levels of ^{10}B with excitation energies between 8.665 and 15.0 MeV. Angular distributions of the second-step decay are well described by model-independent calculations including the polarization of the intermediate nucleus. Lower limits for the spins of six levels could be extracted. (auth)

2025 A CALCULATION OF THE EFFECTIVE INTERACTION IN ^{18}O INCLUDING SELF-CONSISTENCY EFFECTS. Comins, H. N. (Flinders Univ. of South Australia, Bedford Park. School of Physical Sciences); Hewitt, R. G. L. (Sydney Univ. (Australia). Daily Telegraph Dept. of Theoretical Physics). Nucl. Phys., A; 228: No. 1, 153-164(5 Aug 1974).

A perturbation calculation to third order of the J = 0 levels of ^{18}O is described. Self-consistency and other insertion effects are included by using a procedure given in an earlier paper by the same authors. These effects are found to be important and to result in significant quantitative differences from previous calculations. (auth)

2026 SELECTIVITY IN THE ^{11}B(^{3}He,^{6}Li)^{8}Be REACTION. Detraz, C.; Pougheon, F.; Bernas, M.; Langevin, M.; Roussel, P.; Vernotte, J. (Paris-11 Univ., 91–Orsay (France). Inst. de Physique Nucleaire). Nucl. Phys., A; 228: No. 1, 39-51(5 Aug 1974).

The ^{11}B(^{3}He,^{6}Li)^{8}Be reaction was studied at 26 MeV incident energy. Angular distributions and excitation functions were measured. The unobserved 1^+, T = 0 18.15-MeV state is at least one order of magnitude less populated than the 1^+, T = 1 17.64-MeV state. This selectivity between the two 1^+ states suggests that one configuration only of the three transferred nucleons is involved in the (^{3}He,^{6}Li) reaction. An analysis performed under the assumption of triton pickup is shown to predict the occurrence of such selectivities, although it cannot account for the one observed using current shell-model wave functions. (auth)

2027 STRUCTURE OF 0^+ STATES IN ^{18}O. Fortune, H. T. (Argonne National Lab., Ill. (USA)); Headley, S. C. (Pennsylvania Univ., Philadelphia (USA)). Phys. Lett., B; 51: No. 2, 136-138 (22 Jul 1974).

Analysis of spectroscopic factors obtained in single-nucleon-transfer reactions leading to and from ^{18}O yields two different sets of wave functions for the first three 0^+ states. One set of wave functions is in agreement with ^{16}O(t,p)^{18}O data for the three states—the other set is not. The wave functions that agree with the experimental data have the majority of the $(s_{\frac{1}{2}})^2$ strength in the third 0^+ state. (auth)

2028 MULTISTEP TRANSFER PROCESSES IN INELASTIC HEAVY ION REACTIONS. Baur, G. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F.R. Germany)); Wolter, H. H. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Kernphysik). Phys. Lett., B; 51: No. 3, 205-208(5 Aug 1974).

Multistep transfer contributions in inelastic heavy-ion scattering are investigated in a coupled-channels model for the reaction ^{17}O(^{16}O,^{16}O)^{17}O($\frac{1}{2}^+$, 0.871 MeV). It is found that only the interference of the one- and two-step transfer contributions gives agreement with recent experimental results. This result is interpreted as strong evidence for multistep processes in heavy-ion scattering. (auth)

2029 BRANCHING RATIO FOR RADIATIVE PION CAPTURE IN ^{16}O. Szydlik, P. (State Univ. Coll., Plattsburgh, N. Y. (USA)); Werntz, C. (Catholic Univ. of America, Washington, D.C. (USA)). Phys. Lett., B; 51: No. 3, 209-211(5 Aug 1974).

The distorted-wave impulse approximation is used in conjunction with semiphenomenological matrix elements obtained from weak and electromagnetic processes to calculate the branching ratio for radiative pion capture from low-lying atomic orbits in ^{16}O to the bound states of ^{16}N. (auth)

2030 ^{6}Li(e,e'α) AND (e,e'd) REACTIONS. Toyama, M. (Kyoto Sangyo Univ. (Japan). Dept. of Physics); Sakamoto, Y. (Frankfurt Univ. (F.R. Germany). Inst. fuer Kernphysik). Phys. Lett., B; 51: No. 3, 217-220(5 Aug 1974).

The correlation cross sections for the quasifree scattering in the ^{6}Li(e,e'α) and (e,e'd) reactions are calculated in the microscopic model. The internal momentum distributions of clustering particles play an important role for explaining experimental data. (auth)

2031 CORE POLARIZATION VIA CORE DIAGONALIZATION IN OXYGEN. Goode, P. (Rutgers–The State Univ., New Brunswick, N. J. (USA). Dept. of Physics); Kirson, M. W. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics). Phys. Lett., B; 51: No. 3, 221-224(5 Aug 1974).

A comparison is made between inclusion of high-order perturbation-theory terms in the effective interaction by diagonalization of core phonons and by infinite partial summations. The final results of the two methods are found to be qualitatively similar. (auth)

2032 THE PERSISTENCE OF SUPERMULTIPLET SELECTION RULES IN NUCLEAR WEAK AND ELECTROMAGNETIC TRANSITIONS. Mukhopadhyay, N. C. (European Organization for Nuclear Research, Geneva (Switzerland)); Cannata, F. (Bologna Univ. (Italy). Istituto di Fisica). Phys. Lett., B; 51: No. 3, 225-228(5 Aug 1974).

The nuclear supermultiplet symmetry, although broken, is shown to be useful in interpreting the existence of the isovector giant magnetic dipole resonances. Supermultiplet doorways are responsible for the saturation of the magnetic dipole strength. Persistence of the nuclear SU(4) selection rules in light nuclei and its relevance to allowed muon capture and related processes are examined. (auth)

2033 A SELF-CONSISTENT PARTICLE SPECTRUM FOR BRUECKNER CALCULATIONS. Gambhir, Y. K. (Indian Inst. of Tech., Bombay. Dept. of Physics); McCarthy, R. J. (Indiana Univ., Bloomington (USA). Dept. of Physics). Nucl. Phys., A; 228: No. 2, 246-252(12 Aug 1974).

The energies of low-lying intermediate states used in Brueckner calculations on ^{16}O are calculated self-consistently. When the spectrum for higher intermediate states is chosen to join smoothly to the self-consistent results, the binding energy per nucleon for ^{16}O is found to be about 7 MeV. (auth)

2034 INTERMEDIATE-COUPLING CALCULATION FOR ^{10}B IN A PROJECTED HARTREE–FOCK BASIS. Bouten, M.; Bouten, M. C. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Nucl. Phys., A; 228: No. 2, 314-322(12 Aug 1974).

A shell-model calculation is carried out for ^{10}B in intermediate coupling. The deformation of the shell-model field is taken into account by using as a basis the functions obtained from a projected Hartree–Fock calculation. The resulting wave functions give an important improvement for the E2 matrix elements with respect to the conventional shell model. Some remaining difficulties are discussed. (auth)

2035 THE (p,2p) REACTION ON ^{6}Li. Prats, F. (Junta de Energia Nuclear, Madrid (Spain)). Nucl. Phys., A; 227: No. 3, 469-484(29 Jul 1974).

The differential cross section for the quasi-elastic scattering of protons on ^{6}Li is derived in the impulse approximation. The nucleus ^{5}He is not treated as a bound nucleus in the derivation. Instead, the n–α interactions $s_{\frac{1}{2}}$, $p_{\frac{3}{2}}$, $p_{\frac{1}{2}}$ and $d_{\frac{5}{2}}$ in the final state are included. Fits to the unknown vertex functions appearing in the expression obtained for the momentum distribution at the "ground state" of ^{5}He are given, showing that the n–α $s_{\frac{1}{2}}$ inter-

action is important at the "ground state" of ^{5}He. The consistency between the observed momentum distribution and the ^{6}Li form factor at low momentum transfers is shown utilizing Elton's model. (auth)

2036 ENERGY LEVELS OF LIGHT NUCLEI A = 5–10. Ajzenberg-Selove, F.; Lauritsen, T. (California Inst. of Tech., Pasadena (USA)). Nucl. Phys., A; 227: No. 1, 1-244(15 Jul 1974).

Existing experimental information on the properties of the nuclei with mass numbers five through ten is summarized. In form, arrangement and purpose, it is similar to the previous (Nucl. Phys., A V. 78 p. 1 1966) review paper dealing with the nuclei of A = 5–10. Each nucleus is represented by a diagram and a master table exhibiting the known properties of the energy levels, and a listing of the nuclear reactions from which the information derives. The accompanying text contains an abbreviated discussion and a selected bibliography for each relevant reaction. (auth)

2037 ASSIGNMENT OF $J^\pi = 6^+$ TO TWO STATES OF ^{16}O VIA THE ^{12}C(α,^{8}Be)^{8}Be REACTION. James, D. R.; Artz, J. L.; Greenfield, M. B.; Fletcher, N. R. (Florida State Univ., Tallahassee (USA). Dept. of Physics). Nucl. Phys., A; 227: No. 2, 349-356 (22 Jul 1974).

Excitation functions for the reaction ^{12}C(α,^{8}Be)^{8}Be have been measured for approximate c.m. angles of 90°, 69°, and 48°, the latter two angles corresponding to $P_4(\cos\theta_{c.m.}) \sim 0$ and $P_6(\cos\theta_{c.m.}) \sim 0$. Angular distributions were measured at bombarding energies corresponding to the two prominent resonances in ^{16}O at E_α = 21.3 and 22.31 MeV. A J^π assignment of 6^+ is made for each of these states. (auth)

2038 (n,t) AND (n,α) REACTIONS ON ^{9}Be. Perroud, J. P.; Sellem, Ch. (Lausanne Univ. (Switzerland). Inst. de Physique Nucleaire). Nucl. Phys., A; 227: No. 2, 330-340(22 Jul 1974).

A metallic ^{9}Be target was bombarded with 13.99-MeV neutrons; α-particles, tritons and ^{6}He recoil nuclei were detected and identified with a telescope consisting of two proportional counters and a solid state detector. Absolute differential cross sections were measured for the (n,t) reactions leading to the ground state and first excited state of ^{7}Li and for the (n,α) reactions leading to the ground state and first excited state of ^{6}He. No evidence for higher excited states in ^{6}He has been found. An attempt has been made to interpret the observed (n,α) angular distributions in terms of the direct reaction model. (auth)

2039 POSITIVE PION PRODUCTION ON ^{16}O, ^{28}Si AND ^{40}Ca BY 185 MeV PROTONS. Dahlgren, S.; Grafstroem, P.; Hoeistad, B.; Aasberg, A. (Uppsala Univ. (Sweden). Gustaf Werner Institutet). Nucl. Phys., A; 227: No. 2, 245-256(22 Jul 1974).

Positive pion production induced by 185-MeV protons captured by the nuclei ^{16}O, ^{28}Si and ^{40}Ca is measured in the angular region 15–130°. The reported energy spectra of the pions contain peaks corresponding to individual states of the residual nuclei. Angular distributions for these peaks are presented in graphs. Energy levels in ^{12}C, ^{17}O, ^{28}Si and ^{41}Ca with the same shell-model configurations are observed to give rise to very similar angular distributions. Cross sections calculated in the one-nucleon model are compared with the experimental distributions from the $1d_{\frac{5}{2}}$,$2s_{\frac{1}{2}}$ states in ^{17}O and the $1f_{\frac{7}{2}}$ state in ^{41}Ca. (auth)

2040 INTERFERENCE EFFECTS IN ^{12}C(p,γ)^{13}N AND DIRECT CAPTURE TO UNBOUND STATES. Rolfs, C.; Azuma, R. E. (Toronto Univ., Ontario (Canada)). Nucl. Phys., A; 227: No. 2, 291-308(22 Jul 1974).

Excitation functions for the capture reaction ^{12}C(p,γ_0)^{13}N have been obtained at θ_γ = 0° and 90° and E_p = 150–2500 keV. The results can be explained if a direct radiative capture process, E1 (s and d → p), to the ground state in ^{13}N is included in the analysis in addition to the two well-known resonances in this beam energy range [E_p = 457 ($\frac{1}{2}^+$) and 1699 ($\frac{3}{2}^-$) keV]. The direct capture component is enhanced through interference effects with the two resonance amplitudes. From the observed direct capture cross section, a spectroscopic factor of C^2S (l = 1) = 0.49 ± 0.15 has been deduced for the $\frac{1}{2}^-$ ground state in ^{13}N. Excitation functions for the reaction ^{12}C(p,γ_1p')^{12}C have been obtained at θ_γ = 0° and 90° and E_p = 610–2700 keV. Away from the 1699-keV resonance the capture γ-ray yield is dominated by the direct capture process E1 (p → s) to the 2366 ($\frac{1}{2}^+$)-keV unbound state. Above E_p = 1 MeV, the observed excitation functions are well reproduced by the direct capture theory to unbound states (bremsstrahlung theory). Below E_p = 1 MeV, i.e., at E_p → 457 keV, the theory diverges in contrast to observation. This discrepancy is well known in bremsstrahlung theory as the "infrared problem". From the observed direct capture cross sections at $E_p \gtrsim 1$ MeV, a spectroscopic factor of C^2S (l = 0) = 1.02 ± 0.15 has been found for the 2366 ($\frac{1}{2}^+$)-keV unbound state. A search for direct capture transitions to the 3512 ($\frac{3}{2}^-$)- and 3547 ($\frac{1}{2}^+$)-keV unbound states resulted in upper limits of C^2S (l = 1) $\lesssim$ 0.5 and C^2S (l = 2) $\lesssim$ 1.0, respectively. The results are compared with available stripping data as well as shell-model calculations. The astrophysical aspect of the ^{12}C(p,γ_0)^{13}N reaction also is discussed. (auth)

2041 RESONANCES IN ^{12}C+^{12}C. Crozier, D.J.; Legg, J.C. (Kansas State University, Manhattan, Kansas 66506). Phys. Rev. Lett. 33: No. 13, 782-784 (23 Sept 1974).

Resonant structures at 9.4 and 10.3 MeV c.m. energy have been observed in both the reaction ^{12}C(^{12}C, α)^{20}Ne and the elastic scattering of ^{12}C from ^{12}C. Unambiguous assignments of l=7 for both of the resonances are made. (auth)

2042 GIANT–DIPOLE–RESONANCE REGION OF ^{15}N OBSERVED VIA ^{14}C(p,p)^{14}C CROSS SECTION AND POLARIZATION MEASUREMENTS. Weller, H.R. (Department of Physics, University of Florida, Gainesville, Florida 32611); Roberson, N.R.; Rickel, D.; Tilley, D.R. Phys. Rev. Lett. 33: No. 11, 657-659 (9 Sept 1974).

Cross sections and polarizations have been measured for ^{14}C(p,p)^{14}C scattering over the energy range corresponding to the giant–dipole–resonance region of ^{15}N. The results indicate a $J^\pi = 3/2^+$ resonance of about Γ = 4 MeV near Ep = 10 MeV. This resonance appears to be the giant dipole resonance observed in (p,γ) measurements. (auth)

2043 HEAVY–ION TRANSFER REACTIONS AT LOW ENERGIES. Switkowski, Z.E.; Wieland, R.M.; Winther, A. (California Institute of Technology, Pasadena, California 91109). Phys. Rev. Lett. 33: No. 14, 840-842 (30 Sept 1974).

Simple asymptotic expressions are obtained for the optimum Q value and for the total heavy–ion transfer cross section with optimum Q value at energies well below the barrier. For such reactions transfer processes are predicted to be more important than compound reactions, in agreement with measurements performed on the ^{10}B+^{16}O system. Calculations on transfer reactions between ^{12}C and ^{16}O, of current interest in nucleosynthesis, indicate direct reactions to be of no significance. (auth)

2044 ELECTROEXCITATION OF THE GIANT RESONANCE IN ^{16}O. Hotta, A. (Department of Liberal Arts, Shizuoka University, Shizuoka, Japan); Itoh, K.; Saito, T. Phys. Rev. Lett. 33: No. 13, 790-794 (23 Sept 1974).

Electroexcitation of ^{16}O has been measured. The strengths for the E2 (or E0) resonances were extracted from the longitudinal form factors. In the region of 20–30–MeV excitation the strength exhausts approximately 20% of the sum rule for an E2 interpretation, while the strength in the region below 20 MeV exhausts 43% of the same sum rule. The transverse form factor is compared with calculation using both the one–particle, one–hole and the generalized Goldhaber–Teller models. (auth)

2045 QUADRUPOLE FORMFACTOR OF THE ^{15}N NUCLEUS. Vakil, R. Kh.; Gul'karov, I. S. (Tashkent State Univ.). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 3, 76-80(1974). (In Russian).

Experimental data on elastic and inelastic scattering of electrons (with excitation of the 6.33 MeV energy level) having an initial energy of 250 and 400 MeV on the ^{15}N nucleus are compared with the predictions of a number of models. Determinations were made on parameters characterizing the charge density distribution (CDD) and the transition density (TD). The transition density parameters are 10 to 15% smaller than the parameters for the charge density distribution. (SJR)

2046 EXCITED STATE OF ^{12}C AT 18.36 MeV. Goulard, G. (College Militaire Royal de Saint-Jean, Quebec); Turcotte, G. Can. J. Phys.; 52: No. 15, 1476-1484(1 Aug 1974).

The energy level of ^{12}C at 18.36 MeV is investigated with the reaction ^{11}B(p,α)2α. Both suggested values, 2^+ and 3^-, for its spin and parity are used to compute the cross section in the laboratory σ_L, which corresponds to the detection of two alphas of the final state. Comparison of σ_L with the experimental data confirms that 3^- is the most probable value. A tentative evaluation of the percentage of different outgoing channels is given in order to complete the analysis. (auth)

2047 RADIATIVE PION CAPTURE IN FLIGHT AND CHARGED PION PHOTOPRODUCTION IN NUCLEI. Cannata, F.; Lamers, B. A.; Lucas, C. W.; Nagl, A.; Uberall, H.; Werntz, C. (Catholic Univ. of America, Washington, DC). Can. J. Phys.; 52: No. 15, 1405-1415(1 Aug 1974).

Differential and total cross sections are calculated for charged pion photoproduction and radiative pion capture in flight close to threshold ($E_\gamma \lesssim 180$ MeV or $T_\pi \lesssim 40$ MeV), mainly for a target of ^{12}C. At the lower energies, selective bound state excitation may be studied in photoproduction since the giant resonance is kinematically suppressed here. Pion absorption is found to increase considerably with decreasing pion energy due to a $1/v_\pi$ factor, and it shows a dip in the forward direction except for the 1^+ state. Dis-

tortion and absorption effects on the pion are calculated, and are estimated to lead to only a small reduction of the cross section in the energy region considered. (auth)

2048 LIFETIMES OF LOW LYING LEVELS OF ^{18}O, ^{18}Ne. McDonald, A. B.; Alexander, T. K.; Hausser, O.; Costa, G. J.; Forster, J. S.; Olin, A. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys.; 52: No. 15, 1381-1388(1 Aug 1974).

The T(^{16}O,p)^{18}O reaction was employed to measure the lifetimes of the 1.98 MeV 2^+ level (τ = 3.35 ± 0.20 ps) and the 3.55 MeV 4^+ level (τ = 24.5 ± 3.3 ps) of ^{18}O by the recoil distance method. The lifetime of the 1.89 MeV 2^+ level of ^{18}Ne(τ = 0.63 ± 0.13 ps) was measured by observing the Doppler shift attenuation of γ rays from ^{18}Ne ions recoiling from the ^{16}O(^{3}He,n) reaction into Y and Ta backings. Transition rates in these mirror nuclei are compared with theoretical predictions. (auth)

2049 GROUND STATE RADIATION WIDTH OF THE 10.18 MeV $J^\pi = 3^-$, STATE IN ^{28}Si DEDUCED FROM 100 MeV PROTON INELASTIC SCATTERING. Horowitz, Y. S. (Ben Gurion Univ. of the Negev, Beersheva, Israel). Can. J. Phys.; 52: No. 14, 1369-1371(15 Jul 1974).

Differential cross section data for 100-MeV protons inelastically scattered from ^{6}Li, ^{9}Be, ^{12}C, ^{24}Mg, and ^{28}Si are compared with the corresponding E2 and E3 transition rates and a strong correlation is shown to exist between $(d\sigma/d\Omega)_{max}$ and Γ_γ^0 if the shape of the proton angular distribution is characteristic of single excitation. The persistence of the correlation to transitions with $\Gamma_\gamma^0/\Gamma_\gamma$ < 0.1 allows an estimate of Γ_γ^0 = 8.6 ± 5 × 10^{-4} eV for the 10.18 MeV, $J^\pi = 3^-$, level in ^{28}Si. (auth)

2050 PROTON INDUCED SPALLATION OF CARBON: ASTROPHYSICAL IMPLICATIONS FOR NUCLEOSYNTHESIS OF Li, Be, AND B. Roche, C. T. College Park, MD; Univ. of Maryland (1974). 188p. University Microfilms Order No. 74-22,680.

Thesis (Ph. D.).

Cross sections for the production of mass 6 to 11 nuclei by proton spallation of carbon were measured for proton energies between 45 and 100 MeV. The reaction product mass was obtained using the time-of-flight technique. Mass spectra and particle energy spectra for each mass were determined for angles between 10 and 150° at each bombardment energy. The total cross sections were determined by integration of the angular distributions. Knowledge of these cross sections is important in attempting to understand the origin of the light elements Li, Be and B. Production of Li, Be and B by proton spallation of C, N, O is a major mechanism in a number of theories of nucleosynthesis. The maximum of the excitation function for production of ^{6}Li, ^{7}Li, ^{9}Be and ^{10}B from carbon occurs between 45 to 100 MeV, as determined in the present work. Elemental and isotopic abundance ratios for Li, Be and B are calculated using a C, N, O target mixture and a proton flux of the form $E^{-\gamma}$. The ^{7}Li/^{6}Li, ^{11}B/^{10}B and Li/Be cosmic abundance ratios are best reproduced by assuming a hard spectrum (γ < 2) and production of a significant portion of ^{7}Li by an alternate mechanism. The large increase in the boron abundance recently reported by Cameron et al., is best reproduced in a soft spectrum. (Diss. Abstr. Int., B)

2051 CROSS-SECTION REQUIREMENTS FOR CHARGED-PARTICLE FUSION REACTORS: THE ^{6}Li(p,^{3}He)α REACTION. Gould, C. R. (North Carolina State Univ., Raleigh); Nelson, R. O.; Williams, J. R.; Boyce, J. R. Nucl. Sci. Eng.; 55: No. 3, 267-272(Nov 1974).

Absolute cross-section measurements for reactions among light-mass nuclei (A < 10) are important in feasibility studies of controlled thermonuclear reactor systems. For a ^{6}Li–d fueled fusion reactor, the ^{6}Li(p,^{3}He)α reaction is of particular interest. The absolute cross sections for this reaction are incomplete and poorly known, and were accordingly remeasured in the range E_p = 3 to 12 MeV. The results support recent measurements below 3 MeV in finding the cross section to be higher in this region than previously supposed. Additional results for the ^{6}Li(p,p)^{6}Li and ^{6}Li(p,p')^{6}Li* reactions imply the cross sections for these reactions are ~40% higher than earlier measurements. A plot of the Maxwell-averaged reaction rate parameter, $\overline{\sigma v}$, for the ^{6}Li(p,^{3}He)α reaction is presented as a function of kT, the temperature of a p–^{6}Li plasma. (6 figures) (auth)

2052 ^{15}N(p,γ)^{16}O AND ^{13}C(^{3}He,γ)^{16}O TO EXCITED STATES OF ^{16}O. Chew, S. H.; Lowe, J.; Nelson, J. M. (Birmingham Univ. (UK). Dept. of Physics); Barnett, A. R. (Manchester Univ. (UK). Dept. of Physics). Nucl. Phys., A; 229: No. 2, 241-255(2 Sep 1974).

Measurements are reported of the excitation function for ^{15}N(p,γ_1 + γ_2)^{16}O. Together with earlier data, the range E_p = 6–19.6 MeV is covered and is found to contain seven resonances. Coincidence measurements are described which, together with other data, establish that all seven decay to the $J^\pi = 3^-$ state at 6.13 MeV. One of these states is tentatively identified as the giant M2 state observed in inelastic electron scattering. Three higher states are attributed to the $(1p_{\frac{1}{2}}^{-1}\ 1f_{\frac{5}{2}})$ excitation. The excitation function for ^{13}C (^{3}He, γ_1 + γ_2)^{16}O is also given for $E_{^3He}$ = 4–12 MeV. One resonance is found, which probably decays to the $J^\pi = 0^+$ state at 6.05 MeV, and, if so, is part of the deformed giant resonance in ^{16}O. (auth)

2053 ELASTIC SCATTERING OF ^{16}O BY ^{16}O. Halbert, M. L.; Fulmer, C. B.; Raman, S.; Saltmarsh, M. J.; Snell, A. H.; Stelson, P. H. (Oak Ridge National Lab., Tenn. (USA)). Phys. Lett., B; 51: No. 4, 341-344(19 Aug 1974).

The cross section for ^{16}O + ^{16}O elastic scattering at 90° c.m. was measured from 35 to 88 MeV c.m. Pronounced structure was observed, as strong as seen earlier in the 20-30 MeV region. Several optical-model potentials derived from data at lower energies fail to predict the observed structure. (auth)

2054 QUASI-ELASTIC ELECTRON SCATTERING (e,e'p) AND (e,e'd) FROM ^{6}Li IN A COINCIDENCE EXPERIMENT. Heimlich, F. H.; Roessle, E. (Freiburg Univ. (F. R. Germany). Fakultaet fuer Physik); Koebberling, M.; Moritz, J.; Schmidt, K. H.; Wegener, D.; Zeller, D. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Experimentelle Kernphysik); Bienlein, J. K.; Bleckwenn, J.; Dinter, H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Nucl. Phys., A; 228: No. 3, 478-492(19 Aug 1974).

Coincidence cross sections for the reactions ^{6}Li(e,e'p) and ^{6}Li(e,e'd) have been measured in the region of quasi-elastic scattering. For incident electrons of 2.5 and 2.7 GeV, the four-momentum transfers to the proton were 6.6 fm^{-2}, 10.0 fm^{-2} and 11.6 fm^{-2}. The proton coincidence data agree with shell-model distributions if a Woods–Saxon potential is assumed and short-range nucleon–nucleon correlations are included. The best fit to the deuteron coincidence data is obtained with a cluster wave function for the p nucleons and a harmonic oscillator wave function for the s nucleons with the deuteron yield from the s shell taken into account. The ratio of the deuteron cross section from ^{6}Li divided by the elastic e–d scattering cross section depends only slightly on the four-momentum transfer and has a value of ≈2. (auth)

2055 INVESTIGATION OF THE ^{16}O(γ,n)^{15}O AND ^{12}C(γ,n)^{11}C REACTION AT PHOTON ENERGIES BETWEEN 150 MeV AND 63 MeV. Schier, H.; Schoch, B. (Mainz Univ. (F. R. Germany). Inst. fuer Kernphysik). Nucl. Phys., A; 229: No. 1, 93-112(26 Aug 1974).

Measurements of the energy distribution of high-energy neutrons emitted in the photodisintegration of ^{16}O and ^{12}C have been performed with a time-of-flight method for four angles (40.2°, 90°, 113.5°, 142.2°) using the electron beam (60 MeV ≤ E ≤ 150 MeV) of the Mainz University Electron Linac. Neutron spectra for "monochromatic" photons were obtained by a difference method. The cross sections extracted from these spectra show a pronounced forward asymmetry and decrease rapidly with increasing photon energy. The data can be described by a phenomenological quasi-deuteron model. (auth)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 2022, 2039, 2041, and 2073.

2056 ELECTROMAGNETIC TRANSITIONS IN THE ^{32}Si NUCLEUS STUDIED BY THE ^{30}Si(t,pγ)^{32}Si REACTION. Guillaume, G.; Rastegar, B.; Fintz, P.; Gallmann, A. (Strasbourg-1 Univ., 67 (France)). Nucl. Phys., A; 227: No. 2, 284-290(22 Jul 1974). (In French).

The γ-decay of ^{32}Si levels was studied in the ^{30}Si(t,p)^{32}Si reaction at E_t = 2.5, 2.9 and 3.3 MeV. Coincident DSA measurements and p–γ angular correlations (method II) yield excitation energies, branching and mixing ratios, spins and mean lifetimes. The levels at 1.94 and 5.29 MeV have $J^\pi = 2^+$ and $3^{(-)}$ and τ_m = 0.48 ± 0.07 and 0.17 ± 0.04 ps, respectively; for six other levels lifetime limits are given. The 5.41, 5.95, 6.19, 6.39 and 6.71 MeV levels have J = 1, 2, 1, 2, and 1, respectively; the latter level has not been observed before. Most of the results are in good agreement with previous data. (auth)

2057 β^- DECAY OF ^{30}Al. Klotz, G.; Walter, G. (Centre National de la Recherche Scientifique, 67–Strasbourg (France). Centre de Recherches Nucleaires). Nucl. Phys., A; 227: No. 2, 341-348(22 Jul 1974). (In French).

Gamma rays following the β^- decay of ^{30}Al have been investigated with a Ge(Li) detector. The ^{30}Al sources were produced by fast neutron bombardment of an enriched ^{30}Si sample. Evidence for two previously unreported β^- branches has been deduced. The existence of allowed β^- transitions to $J^\pi = 2^+$ and 3^+ states and to the $J^\pi = 4^+$ level at 5.95 MeV determines $J^\pi = 3^+$ for the ^{30}Al ground state ($T_{\frac{1}{2}} = 3.56 \pm 0.02$ s). These results are compared to a recent shell-model calculation. (auth)

2058 A STUDY OF THE PHOTONEUTRON CONTRIBUTION TO THE GIANT DIPOLE RESONANCE OF s–d SHELL NUCLEI. Veyssiere, A.; Beil, H.; Bergere, R.; Carlos, P.; Lepretre, A.; de Miniac, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Dept. de Physique Nucleaire). Nucl. Phys., A; 227: No. 3, 513-540(29 Jul 1974).

Partial photoneutron cross sections [$\sigma(\gamma,n) + \sigma(\gamma,pn)$] and $\sigma(\gamma,2n)$ of s–d shell nuclei were measured in the GDR region by means of a continuously variable monochromatic photon beam and a high-efficiency neutron detecting system. In some cases, additional measurements of target-associated β^+ activities made a separation of the (γ,n) from the (γ,pn) reaction possible. It is shown that the mean energy position of the gross resonance shape of the GDR of s–d-shell nuclei does not show a systematic dependence on A, as is the case for heavy nuclei. Further, the average energy positions of the main strength concentrations of the observed "structure" in these GDR are shown to depend strongly on shell effects. An analysis of the competition between the (γ,n), (γ,pn) and $(\gamma,2n)$ exit channels is also carried out. The ratio of the integrated experimental photoneutron cross section σ_0^n to the classical TRK dipole sum rule for A = 4N nuclei is shown to be only half as big as the one obtained for the neighboring A = 4N – 1 nuclei. This ratio shows also a monotonic increase as a function of isospin T for all nuclei. (auth)

2059 THE ^{28}Si(^{3}He,p)^{31}P REACTION AT 16 AND 28 MeV. Hafner, H.; Duhm, H. H. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F.R. Germany)). Nucl. Phys., A; 227: No. 3, 450-468(29 Jul 1974).

The ^{28}Si(^{3}He,p)^{30}P reaction has been measured at incident energies of 16 and 28 MeV. The proton spectra were analyzed with magnetic spectrographs. Angular distributions have been obtained for ^{30}P states up to 5.2 MeV excitation energy. Three sets of shell-model wave functions have been tested for the low-lying states by comparing microscopic DWBA calculations with the experimental angular distributions at the two different bombarding energies. The theoretical DWBA analysis is performed on the basis of the single-step two-nucleon-transfer reaction mechanism. It underestimates the contributions for the large angular momentum transfer components in the experimental angular distributions. (auth)

2060 THE USE OF ^{4}He ION-IMPLANTED TARGETS TO OBTAIN ACCURATE NUCLEAR LIFETIMES FROM ANALYSIS OF DOPPLER BROADENED LINE-SHAPES. Forster, J. S.; Ward, D.; Costa, G. J.; Ball, G. C.; Davies, W. G.; Mitchell, I. V. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Phys. Lett., B; 51: No. 2, 133-135(22 Jul 1974).

The inverse reactions ^{4}He(^{24}Mg,^{4}He)^{24}Mg and ^{4}He(^{35}Cl,p)^{38}Ar have been used to measure the mean lifetimes of the first excited states of ^{24}Mg and ^{38}Ar. The Doppler-broadened line shapes were analyzed using scaled experimental stopping power and yielded results of 1.82 ± 0.14 ps for the 1.37-MeV level in ^{24}Mg and 0.72 ± 0.05 ps for the 2.17-MeV level in ^{38}Ar. (auth)

2061 ELECTROMAGNETIC TRANSITION STRENGTHS IN ^{24}Na. Keverling Buisman, A. S.; Smulders, P. J. M. (Rijksuniversiteit Groningen (Netherlands). Natuurkundig Lab.). Nucl. Phys., A; 228: No. 2, 205-215(12 Aug 1974).

Mean lifetimes, excitation energies and branching ratios of ^{24}Na states populated in the ^{23}Na(d,p)^{24}Na reaction have been measured. Gamma-ray spectra were measured at three angles in coincidence with proton groups at $\theta_p = 169°$. Mean lifetimes obtained from DSA are (excitation energy in keV, lifetime in fs): 563, >1000; 1341, 95 ± 30; 1344, 38 ± 11; 1346, >1500; 1512, 38 ± 11; 1846, 260 ± 50; 1885, 36 ± 9; 2513, 15 ± 7; 2563, <25; 2904, 50 ± 15; 2976, <25; 3216, 22 ± 8; 3372, 19 ± 5. For higher levels up to 4207 keV upper limits of 30 fs were set. In combination with earlier work the following unique spin(–parity) assignments could be made: $J^\pi(1846) = 2^+$, $J(2513) = 3$, $J^\pi(3745) = 3^-$. A new level at $E_x = 3681.7 \pm 0.6$ keV is reported. (auth)

2062 A STUDY OF ^{22}Ne WITH THE ^{20}Ne(t,p) REACTION. Flynn, E. R.; Hansen, O.; Nathan, O. (Los Alamos Scientific Lab., N. Mex. (USA)). Nucl. Phys., A; 228: No. 2, 189-204 (12 Aug 1974).

The ^{20}Ne(t,p)^{22}Ne reaction has been studied at 15 and 20 MeV bombarding energies covering excitation energies up to 12 MeV. The protons were observed in a magnetic spectrograph with an energy resolution of 30–35 keV FWHM. The proton angular distributions are analyzed empirically as well as with DWBA methods, and several final-state spin–parity assignments are made. The DWBA analysis shows that there are important higher-order contributions to the reaction mechanism. A comparison of the 15-MeV (t,p) data with corresponding (τ,p) data leads to the identification of 10 isobaric analog pairs in the mass-22 system. DWBA predictions based on theoretical wave functions are compared to the data, and the overall trends agree reasonably well. (auth)

2063 RESOLVING AMBIGUITIES IN HEAVY–ION POTENTIALS. Goldberg, D.A.; Smith, S.M. (University of Maryland, College Park, Maryland 20742). Phys. Rev. Lett. 33: No. 12, 715-718 (16 Sept 1974).

It is shown that nuclear (as opposed to Coulomb) rainbow–scattering data would be useful in discriminating among heavy–ion optical potentials. Acquisition of such data is facilitated by going to higher bombarding energies and using low–A targets. (auth)

2064 SHAPES OF (^{6}Li,d) ANGULAR DISTRIBUTIONS AS SIGNATURES OF ROTATIONAL BANDS IN ^{29}Si. Anantaraman, N.; Draayer, J.P.; Gove, H.E.; Trentelman, J.P. (Nuclear Structure Research Laboratory, University of Rochester, Rochester, New York 14627). Phys. Rev. Lett. 33: No. 14, 846-848 (30 Sept 1974).

Angular distributions obtained in a study of the ^{25}Mg(^{6}Li,d) reaction at E_{Li}=36 MeV are characterized by the lowest allowed L transfers for cluster transitions to the members of the ground–state rotational band of ^{29}Si, while a mixture of L values is required for states of the $K=3/2^+$ excited band. This demonstrates that an α–transfer reaction can probe the internal structure of the nucleus in a way that can be deciphered. (auth)

2065 ENTRANCE–CHANNEL EFFECTS IN THE ^{32}S SYSTEM: COMPARISON OF ^{12}C+^{20}Ne AND ^{16}O+^{16}O ELASTIC SCATTERING. Vandenbosch, R.; Webb, M.P.; Zisman, M.S. (University of Washington, Seattle, Washington 91895). Phys. Rev. Lett. 33: No. 14, 842-845 (30 Sept 1974).

^{12}C+^{20}Ne elastic–scattering angular distributions have been measured at several energies, and an excitation function has been obtained at 70° center of mass from $E_{c.m.}$=17 to 28 MeV. The ^{12}C+^{20}Ne data are greatly damped compared with ^{16}O+^{16}O data in this energy range. This demonstrates that the absorption is not determined primarily by compound–nuclear properties. The differences are interpreted in terms of the more favorable angular–momentum matching conditions for the ^{12}C+^{20}Ne direct–reaction channels. (auth)

2066 NEGATIVE PARITY LEVELS IN ^{30}Si. Greene, M. W.; Grawe, H. H.; Kuehner, J. A. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 52: No. 16, 1485-1491(15 Aug 1974).

A polarization direction correlation measurement of γ rays from the 7.044 MeV level in ^{30}Si results in $J^\pi = 5^-$ for this level and implies a $J^\pi = 4^-$ assignment for the level at 6.503 MeV. A particle gamma ray coincidence measurement establishes a new decay branch (15 ± 4%) for the 6.503 MeV level to the 5.485 MeV $J^\pi = 3^-$ level. The Doppler shift attenuation method was used to measure the mean lifetime of the 7.044 MeV level as $\tau = 1.4^{+0.4}_{-0.3}$ ps. A simple shell model structure for the low lying negative parity states is presented and shown to be consistent with experimental measurements. (auth)

2067 SPECTROSCOPIC STUDY OF ^{32}S THROUGH THE ^{31}P(d,n)^{32}S REACTION. Hussein, A. H.; Neilson, G. C.; McDonald, W. J.; Dawson, W. K. (Univ. of Alberta, Edmonton). Can. J. Phys.; 52: No. 14, 1288-1294(15 Jul 1974).

The ^{31}P(d,n)^{32}S reaction was studied at deuteron energies of 4.0 and 5.45 MeV. Neutron energies were measured by time of flight. Absolute differential cross sections of seven levels in ^{32}S were measured and compared with the theoretical predictions of both the DWBA and compound statistical theories. Analysis of the angular distributions yielded l_p values and absolute spectroscopic factors. These results were compared with those from other experiments and shell model predictions. (auth)

2068 HOLE STATES OF ^{20}F AND ^{20}Ne. Millington, G. F.; Leslie, J. R.; McLatchie, W. (Queen's Univ., Kingston, Ontario (Canada). Dept. of Physics); Ball, G. C.; Davies, W. G.; Forster, J. S. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Nucl. Phys., A; 228: No. 3, 382-392(19 Aug 1974).

The structure of the low-lying states of ^{20}F has been investigated with the reaction ^{21}Ne(d,^{3}He)^{20}F induced by 26-MeV deuterons. Spins, parity assignments and spectroscopic factors for the populated states are compared with the predictions of the Nilsson model and recent shell-model and projected Hartree–Fock calculations. The reaction ^{21}Ne(d,t)^{20}Ne, studied simultaneously, excites strongly the T = 1 states in ^{20}Ne which are

analogues of the low-lying states of ^{20}F. The spectroscopic factors of parent and analogue are consistent to within 20% for states excited by a single l-transfer. (auth)

2069 A STUDY OF THE ^{20}Ne(t,α)^{19}F REACTION AT 20 MeV. Garrett, J. D. (Brookhaven National Lab., Upton, N. Y. (USA)); Hansen, O. (Los Alamos Scientific Lab., N. Mex. (USA)). Nucl. Phys., A; 229: No. 2, 204-218(2 Sep 1974).

The ^{20}Ne(t,α) reaction at an incident energy of 20 MeV has been used to study proton hole configurations in ^{19}F. The resulting angular distributions are analyzed by using the DWBA with finite-range and non-local potential corrections. These results are compared to those obtained from a similar analysis of previously measured ^{20}Ne(τ,α) data populating mirror states in ^{19}Ne. The empirical normalization between experimental and DWBA cross sections for the ^{20}Ne(τ,α) reaction appears to be over twice that from the ^{20}Ne(t,α) reaction. The resulting spectroscopic information is compared with model predictions. (auth)

2070 LIFETIMES OF ^{26}Mg, ^{26}Al AND ^{30}Si LEVELS. Beck, F. A.; Byrski, T.; Engelstein, P.; Vivien, J. P. (Strasbourg-1 Univ., 67 (France)). Nucl. Phys., A; 228: No. 3, 393-396(19 Aug 1974).

The recoil-distance method was used to determine the mean lifetimes of ^{26}Mg (3.59 MeV), ^{26}Al (1.76) and ^{30}Si (3.79) as τ_m = 9.5 ± 0.7, 6.3 ± 0.5 and 15.6 ± 1.2 ps, respectively. (auth)

2071 A COMPARISON BETWEEN SHELL-MODEL CONFIGURATION MIXING CALCULATIONS AND THE MCHF MODEL IN THE GROUND STATE ROTATIONAL SPECTRA OF ^{20}Ne, ^{22}Ne AND ^{24}Mg. Krewald, S.; Schmid, K. W.; Faessler, A. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik); McGrory, J. B. (Oak Ridge National Lab., Tenn. (USA)). Nucl. Phys., A; 228: No. 3, 524-532(19 Aug 1974).

Shell-model and multi-configuration Hartree–Fock (MCHF) calculations in an $0d_{\frac{5}{2}}-1s_{\frac{1}{2}}$ oscillator basis are compared for ^{20}Ne, ^{22}Ne and ^{24}Mg. The similarity of the calculated results in the two models shows that the MCHF method is a very good approximation to the shell-model calculations. (auth)

2072 TRANSIENT FIELD MEASUREMENTS OF G-FACTORS FOR ^{24}Mg AND ^{26}Mg. Eberhardt, J. L.; Horstman, R. E.; Heeman, H. W.; van Middelkoop, G. (Rijksuniversiteit Utrecht (Netherlands). Fysisch Lab.). Nucl. Phys., A; 229: No. 1, 162-178(26 Aug 1974).

The g-factors of the first excited $J^\pi = 2^+$ states of ^{24}Mg and ^{26}Mg have been measured with the ion-implantation perturbed-angular-correlation technique (IMPAC). The precession of the spins of nuclei recoiling into a magnetized iron backing is predominantly caused by the transient magnetic field for these very light and short-lived ($\tau_m \approx 1$ ps) nuclei. The transient field, which attains a value of 200 T for the Mg isotopes, is present only during the slowing down of the recoiling nucleus and results in average precession angles of about 1.5 mrad. The experimental results are treated in the framework of the transient field theory of Lindhard and Winther. This yields g-factors of g = +0.42 ± 0.09 and g = +1.3 ± 0.3 for ^{24}Mg and ^{26}Mg, respectively. The results are compared with theoretical predictions and for ^{24}Mg also with a recent time-differential deorientation experiment. (auth)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 1994, 2039, 2058, 2111, 2114, 2188, 2216, and 2223.

2073 (EANDC-95(U)) COMPILATION OF THRESHOLD REACTION NEUTRON CROSS-SECTIONS FOR NEUTRON DOSIMETRY AND OTHER APPLICATIONS. Liskien, H.; Paulsen, A. (NEA Neutron Data Compilation Centre, 91 - Gif-sur-Yvette (France)). Feb 1974. 334p. Dep. NTIS (US Sales Only) $19.75.

This volume is essentially a revision of the "Compilation of Cross-Sections for Some Neutron Induced Threshold Reactions" (EUR 119.e). Data available as of January 1974 are included in tables, but not all are plotted. The following reactions are included: ^{24}Mg(n,p), ^{27}Al(n,α), ^{27}Al(n,p), ^{31}P(n,p), ^{32}S(n,p), ^{46}Ti(n,p), ^{47}Ti(n,p), ^{48}Ti(n,p), ^{55}Mn(n,2n), ^{54}Fe(n,p), ^{56}Fe(n,p), ^{59}Co(n,α), ^{58}Ni(n,α), ^{58}Ni(n,p), ^{63}Cu(n,α), ^{63}Cu(n,2n), ^{65}Cu(n,2n), ^{64}Zn(n,p), ^{93}Nb(n,2n), ^{93}Nb(n,n'), ^{92}Mo(n,p), ^{103}Rh(n,n'), ^{115}In(n,n'), ^{127}I(n,2n), ^{232}Th(n,f), ^{238}U(n,f), ^{236}U(n,f)/^{235}U(n,f), and ^{237}Np(n,f). (RWR)

2074 (KFK–1968) METHOD TO INVESTIGATE NEUTRON INELASTIC CROSS SECTION DATA BY ANALYZING FAST NANOSECOND DECAYING SPECTRA. Pieroni, N. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Systemtechnik und Reaktorphysik; Kernforschungszentrum Karlsruhe (F. R. Germany). Projekt Schneller Brueter). May 1974. 90p. INIS.

18 figs.; 5 tabs.; 41 refs.; with apps. With abstract in English and German.

A method to test and improve neutron inelastic scattering cross section data of reactor materials was developed. It is based on the large sensitivity of fast nanosecond decay leakage spectra of small pulsed systems to the inelastic scattering process. By analyzing the decaying spectra in small energy intervals, quantitative changes in the inelastic cross section data can be introduced to provide agreement between calculation and measurement. In this manner adjusted data can be defined. The method required the use of a reliable spectrometric procedure to measure fast nanosecond time-dependent spectra and an appropriate time-dependent spectra computational procedure. A NE 213 liquid scintillator detector was used in the measurements. The Karlsruhe Monte-Carlo program KAMCCO was adapted for the calculations performed in this study. The method was applied to the study of an iron and a natural uranium system. It was possible to define adjusted inelastic cross section data for iron and ^{238}U. The reliability of the information obtained by the present method was verified through independent experiments. (auth)

2075 GAMMA-RAY-PRODUCTION CROSS SECTIONS FOR THE ^{56}Fe(n,n'γ) REACTION FROM 2.5- TO 14.1-MeV NEUTRON ENERGIES. Lachkar, J.; Sigaud, J.; Patin, Y.; Haouat, G. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France). Nucl. Sci. Eng.; 55: No. 2, 168-187(Oct 1974).

Differential production cross sections for gamma rays from the ^{56}Fe(n,n'γ) reactions are presented for incident-neutron energies between 2.5 and 14.1 MeV. The reactions are studied at 11 neutron energies by using pulsed-beam techniques with the D(d,n)^{3}He reaction and the associated-particle method with the T(d,n)^{4}He reaction as neutron sources and using a sample of natural iron. The excitation functions of 17 gamma-ray transitions were measured between 4.8 and 8.8 MeV incident energies in nine 0.5-MeV steps at an angle of 90 deg. Angular distributions of 13 prominent gamma rays were also measured at 8.8 MeV neutron energy and for the 846.8- and 1238.3-keV gamma rays at 2.5 and 14.1 MeV neutron energies. Comparisons with previously published measurements and with the calculated cross sections of the Hauser–Feshbach formalism are presented. The calculated cross sections include the effects of level-width fluctuations, and agree well with the data when all levels observed are included. This agreement renders unnecessary the added contribution from a supposed continuum-like spectrum of unresolved final states for measurements up to 8.8 MeV incident energy. Such a contribution, proposed in previous studies, has been shown to be small. On the basis of the comparison between present data and that of previous authors, such a contribution cannot exceed 15% of the summed cross sections for discrete lines up to 7.3-MeV incident-neutron energy. (11 figures, 9 tables) (auth)

2076 ABSOLUTE DIFFERENTIAL NEUTRON EMISSION CROSS SECTIONS FOR Ti, V, AND Cr AT 14 MeV INCIDENCE ENERGY. Hermsdorf, D.; Sassonoff, S.; Seeliger, D.; Seidel, K. (Technische Univ., Dresden). Kernenergie; 17: No. 6, 176-183 (Jun 1974). (In German).

Neutron emission spectra were measured in an energy range of emitted neutrons E = 1.5 to 14.6 MeV at scattering angles ϑ = 40, 60, 90, 120, and 150° by time-of-flight spectroscopy and absolute determination of the 14-MeV neutron source strength. Cross sections were integrated over energy and solid angle and given graphically as well as in parameterized form. Results are discussed in detail. The material existing for more than 30 elements is presented for the nuclei titanium, vanadium, and chromium. (auth)

2077 RESONANCE NEUTRON CAPTURE IN ^{55}Mn AND LEVELS IN ^{56}Mn. Boerner, H.; Schult, O. W. B. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik). Z. Naturforsch., a; 29: No. 3, 385-388(Mar 1974).

The γ-spectrum of ^{56}Mn from resonance neutron capture in ^{55}Mn has been measured in the energy range 4.2 ≤ E ≤ 7.3 MeV. The 215-keV level of ^{56}Mn was found to be populated through about 30% of the primary γ-ray intensity leading to the 212/215 keV doublet. (auth)

2078 RADIATIVE MUON CAPTURE IN ^{40}Ca. Rood, H. P. C. (Rijksuniversiteit Groningen (Netherlands)); Yano, A. F. (California State Univ., Long Beach, Calif., USA); Yano, F. B. (California State Univ., Los Angeles, Calif., USA). Nucl. Phys., A; 228: No. 2, 333-344(12 Aug 1974).

The photon spectrum and angular correlation for radiative muon capture in ^{40}Ca are calculated. The present results show

that the intermediate state propagators appreciably reduce the photon spectrum, when compared with previous calculations of Rood and Tolhoek. However, the theoretical angular correlation still cannot be reconciled with experiment. (auth)

2079 EFFECTS OF PROTON PAIR VARIATIONS IN THE LOW-LYING SPECTRUM OF CLOSED-SHELL NUCLEI: STRUCTURE OF ^{48}Ca. Iachello, F. (Rijksuniversiteit Groningen (Netherlands)); Bastiani, S. (Politecnico di Torino (Italy)). Nucl. Phys., A; 228: No. 2, 356-364(12 Aug 1974).

The importance of proton pair vibrations in the low-lying spectra of closed-shell nuclei with $Z \neq N$ is emphasized. Indications for the occurrence of these states in ^{48}Ca are obtained from a restricted shell-model calculation with both active neutrons and protons. (auth)

2080 THE (d,^{6}Li) REACTION IN THE f-p SHELL AT E_d = 27.25 MeV. Ceballos, A. E.; Erramuspe, H. J.; Ferrero, A. M. J.; Sametband, M. J.; Testoni, J. E.; Bes, D. R.; Maqueda, E. E.; Perazzo, R. P. J.; Reich, S. L. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). Nucl. Phys., A; 228: No. 2, 216-228(12 Aug 1974).

The differential cross sections for the reactions ^{56}Fe(d,^{6}Li)^{52}Cr and ^{58}Ni(d,^{6}Li)^{54}Fe leading to the ground 0^+ and the first 2^+ excited states are measured at 27.25 MeV. A DWBA analysis of these data and those previously obtained for three Zn isotopes at the same energy is performed. The calculation of the microscopic form factors is carried out within the framework of different approximations. (auth)

2081 PION SCATTERING ON MEDIUM-WEIGHT NUCLEI AND DISTORTION EFFECTS IN DOUBLE CHARGE EXCHANGE REACTIONS. Gurvitz, S. A.; Rinat, A. S. (Weizmann Inst. of Science, Rehovoth (Israel)). Phys. Lett., B; 51: No. 2, 109-112(22 Jul 1974).

An eikonal version of the DWIA is used to compute absorption and dispersion effects on the cross section for double charge exchange to its double analog. Information on the π-^{51}V optical potential being lacking, recent data on π-^{40}Ca elastic scattering have been analyzed in the Glauber approximation, and the extracted elastic phase function has been scaled up to correspond to ^{51}V. The result is used in a computation of the DWIA amplitude. Large reduction factors are obtained in agreement with experimental upper bounds. Discrepancies with previous estimates are discussed. (auth)

2082 SPIN ASSIGNMENTS IN ^{63}Ni THROUGH ^{62}Ni($\vec{d}$,p)^{63}Ni. Huttlin, G. A.; Sen, S.; Yoh, W. A.; Rollefson, A. A. (Notre Dame Univ., Ind. (USA). Dept. of Physics). Nucl. Phys., A; 227: No. 3, 389-398(29 Jul 1974).

Angular distributions of vector analyzing power have been measured for the reaction ^{62}Ni($\vec{d}$,p)^{63}Ni at a beam energy of 10 MeV. The observed j-dependence of vector analyzing power alloys unambiguous spin assignments to be made for the following states in ^{63}Ni (excitation energies in MeV): 0, $\frac{1}{2}^-$; 0.087, $\frac{5}{2}^-$; 0.155, $\frac{3}{2}^-$; 0.515, $\frac{3}{2}^-$; 1.003, $\frac{1}{2}^-$; 2.297, $\frac{3}{2}^+$; 2.700, $\frac{1}{2}^-$; 2.953, $\frac{1}{2}^+$; 3.292, $\frac{5}{2}^+$; 3.932, $\frac{5}{2}^+$; 3.951, $\frac{5}{2}^+$; 4.387, $\frac{5}{2}^+$. An assignment of $\frac{3}{2}^+$ is suggested for the state at 2.519 MeV. The data for the unresolved l_n = 4, 1 doublet (1.294, 1.327) MeV indicate the $\frac{3}{2}^-$ spin assignment for the 1.327 MeV state. The main features of all the data are in agreement with DWBA calculations. (auth)

2083 STRUCTURE OF ^{57}Fe STUDIED WITH ^{56}Fe($\vec{d}$,p)^{57}Fe REACTIONS. Thomson, J. A. (Wisconsin Univ., Madison (USA)). Nucl. Phys., A; 227: No. 3, 485-505(29 Jul 1974).

^{56}Fe($\vec{d}$,p)^{57}Fe reactions have been studied with 10-MeV vector polarized deuterons over the angular range $15° \leq \theta_p \leq 80°$. Angular distributions of the vector analyzing power and the differential cross section have been measured for reactions leading to levels in ^{57}Fe. Distorted-wave Born-approximation calculations are compared to the measurements. The observed j-dependence of the vector analyzing power results in eighteen new spin-parity assignments for levels in ^{57}Fe. Spectroscopic factors are extracted from the differential cross-section measurements. The results are compared to the predictions of the single-particle shell model and to models including collective structure. (auth)

2084 COEXISTENCE OF THE CORE EXCITED STATES IN ^{56}Ni. Shimizu, K.; Arima, A. (State Univ. of New York, Stony Brook (USA)). Nucl. Phys., A; 227: No. 2, 357-372(22 Jul 1974).

In a shell model calculation of the low-lying states in ^{56}Ni, 3p-1h and 4p-2h configurations are taken into account together with the two-particle configurations in the $1p_{\frac{3}{2}}$, $0f_{\frac{5}{2}}$ and $1p_{\frac{1}{2}}$ orbits outside the ^{56}Ni core. In order to truncate the three-particle and four-particle configurations, the pseudo SU(3) coupling scheme is employed which is supposed to be suitable for the description of the collective rotational character. To explain the enhanced E2 transition from the first 2^+ state to the ground state, a nucleon effective charge of 1.05 e is needed, which is consistent with the value calculated based using perturbation theory. The spectroscopic factors of the α-transfer reaction are also calculated and compared with the recent observed values. (auth)

2085 STUDY OF ENERGY LEVELS OF ^{47}Sc BY THE ^{45}Sc(t,p)^{47}Sc REACTION. Delbrouck-Habaru, J. M.; Baudinet-Robinet, Y. (Liege Univ. (Belgium). Inst. de Physique Nucleaire). Nucl. Phys., A; 227: No. 2, 257-276(22 Jul 1974). (In French).

The energy levels of ^{47}Sc are investigated through the ^{45}Sc(t,p)^{47}Sc reaction using 11.8-MeV incident tritons and a multigap magnetic spectrograph with nuclear emulsions to analyze the resulting protons. Seventy states are excited in ^{47}Sc up to 6.9 MeV. The data are analyzed using the distorted-wave Born approximation, and values of the orbital angular momentum L of the transferred neutron pair are derived for 28 levels. Good agreement with previous results is generally obtained, new states in ^{47}Sc are detected, and more precise information on the spins of some levels in ^{47}Sc is deduced. The results are compared with shell-model calculations. Strong L = 0 and mixed L = 0 + 2 transitions to ^{47}Sc levels other than the ground states are detected, and qualitative explanations for them are presented. (auth)

2086 THOMAS-EHRMAN SHIFTS IN ^{41}Ca-^{41}Sc. Wilson, W. M. Jr.; Moses, J. D.; Bilpuch, E. G. (Duke Univ., Durham, N. C. (USA)); Mitchell, G. E. (North Carolina State Univ., Raleigh (USA)). Nucl. Phys., A; 227: No. 2, 277-283(22 Jul 1974).

Differential cross sections were measured for ^{40}Ca(p,p) at four angles from E_p = 1.80 to 2.90 MeV with an overall energy resolution of about 400 eV. Spins, parities, proton widths, and reduced widths were extracted for the five observed levels. The ambiguities in several of the spin assignments determined from a previous experiment have been removed in the present work. The Thomas-Ehrman "boundary condition level displacement" was calculated for each of the five levels in the mirror system. These calculations are in qualitative agreement with the observed displacements. There is evidence that the $\frac{3}{2}^-$ level at E_x = 3.77 MeV in ^{41}Sc is the analog of the second member of the recently resolved 3.74 MeV doublet in ^{41}Ca. (auth)

2087 NUCLEAR STRUCTURE OF ^{47}Sc. I. Gamma-Ray Correlations and Lifetime Measurements. Toulemonde, M.; Deschenes, L.; Jamshidi, A.; Schulz, N. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Lab. de Physique du Noyau et de Physique des Particules). Nucl. Phys., A; 227: No. 2, 309-324(22 Jul 1974).

Levels of ^{47}Sc below an excitation energy of 2.7 MeV have been investigated through the ^{44}Ca(α,pγ)^{47}Sc reaction. Gamma-ray spectra in coincidence with protons were recorded with a Ge(Li) detector positioned at several angles and at α energies of 10.15 and 11.00 MeV. Level positions, lifetimes, decay modes and spin values were deduced from these measurements. This study was supplemented by a γ-γ coincidence measurement. The electromagnetic properties for the negative-parity states are compared with intermediate coupling predictions. A classification of the positive-parity states into several rotational bands is proposed. (auth)

2088 NUCLEAR STRUCTURE OF ^{47}Sc. II. Linear Polarization Measurement for the 1147 keV γ-Transition. Toulemonde, M.; Engelstein, P.; Jamshidi, A.; Schulz, N. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Lab. de Physique du Noyau et de Physique des Particules). Nucl. Phys., A; 227: No. 2, 325-329(22 Jul 1974).

The linear polarization of the rays de-exciting the ^{47}Sc 1147-keV level has been measured. This, together with the results of a recent angular correlation measurement, fixes the angular momentum of the 1147-keV level as $\frac{11}{2}$. (auth)

2089 REACTION ^{40}Ca(e,e'p) AND OBSERVATION OF THE 1s PROTON STATE. Nakamura, K.; Hiramatsu, S.; Kamae, T.; Muramatsu, H. (Department of Physics, University of Tokyo, Bunkyo-ku, Tokyo, Japan); Izutsu, N.; Watase, Y. Phys. Rev. Lett. 33: No. 14, 853-855 (30 Sept 1974).

The distorted spectral function of the protons in the reaction ^{40}Ca(e,e'p) is measured. For the 2s-1d region the distorted-wave impulse-approximation calculation using the Elton-Swift wave functions explains the data within 20%. The 1p occupation number is 1.7 times that of the shell-model prediction. After correcting for the radiative effects and for the multiple-collision background, the 1s state is clearly observed at $E_x \simeq 58$ MeV with a reasonable occupation number. (auth)

2090 THREE-BODY BREAKUP REACTION ^{40}Ca(^{16}O, ^{12}Cα). Slater, D.C.; Hall, J.R.; Calarco, J.R. (Department of Physics, Stanford University, Stanford, California 94305); Watson, B.A.; Becker, J.A. Phys. Rev. Lett. 33: No. 13, 784-787 (23 Sept 1974).

We report for the first time coincident ^{12}C and α particles emitted in the bombardment of ^{40}Ca with ^{16}O ions of 64 MeV. Events which populate the ground and first excited states of ^{12}C and ^{40}Ca are observed. The coincident ^{12}C energy spectra are dominated by one or two large peaks near the highest allowable ^{12}C energy. Relatively few coincidences are seen at ^{12}C energies which correspond to maximum yield in the $^{40}Ca(^{16}O, ^{12}C)$ singles spectrum. (auth)

2091 NUCLEON–GAMMA COMPETITION FOLLOWING (α,p) AND (α,n) REACTIONS ON ^{54}Fe. Lu, N. H. Seattle; Washington Univ. (1974). 228p. University Microfilms Order No. 74-22,534.

Thesis (Ph. D.).

The α-particle induced reactions on ^{54}Fe were studied primarily by the particle γ-ray coincidence technique. The α-bombardment energies used in this study were 15.5, 17.8, 20.8 and 23.8 MeV. The relative cross sections for independent and cumulative formation of individual levels in ^{57}Co, ^{56}Fe and ^{55}Co were obtained, and were further normalized to match with the radiochemically measured (α,p) cross section at the corresponding bombardment energies. It is found that the reactions induced at 15.5 and 17.8 MeV can be satisfactorily explained by the compound statistical theory for nuclear reactions. By fitting the experimental proton spectra obtained from the 17.8-MeV experiment, the values of 5.3 and 4.6 MeV^{-1} for the level spacing parameter a for ^{57}Co and ^{57}Ni were obtained, respectively. The nuclear moment of inertia that reproduced the relative cross sections for the formation of individual levels, 17.8 MeV experiment, was found to be lower than and approached the rigid body value at high excitation energies. Furthermore, the γ strength that reproduced the $(\alpha,p)/[(\alpha,p) + (\alpha,2p)]$ cross section ratio is represented by the reduced transition probabilities for electric dipole, magnetic dipole and electric quadrupole radiation with the values of 0.15, 0.25, and 11.8 Weisskopf units for transitions initiating at 8 MeV, where competition for branching by γ-ray vs. nuclear emission is most probable for the 17.8-MeV experiments. The above parameters were then used in the calculations for the cross sections for the 20.8-, and 23.8-MeV experiments. At 20.8-, and 23.8-MeV α bombardments, it was found that the measured (α,p) cross sections are larger than that predicted by the compound nucleus theory. This discrepancy is found mainly at low energy of the emitted protons. This is consistent with the picture that high spin states were formed with considerable probability at low excitation energies. This picture could be accounted for by introducing an additional mechanism involving nucleon emission prior to statistical equilibrium. (Diss. Abstr. Int., B)

2092 INELASTIC ALPHA PARTICLE SCATTERING FROM ^{40}Ca AND ^{208}Pb. Rutledge, L. V. Jr. College Station, TX; Texas A and M Univ. (1974). 138p. University Microfilms Order No. 74-21,219.

Thesis (Ph. D.).

Spectra of inelastically scattered alpha particles from ^{40}Ca and ^{208}Pb were obtained using a charge-division position sensitive proportional counter. Strongly excited bound states were observed up to 8.10 MeV of excitation for ^{40}Ca and up to 5.51 MeV of excitation in ^{208}Pb at a bombarding energy of 79.1 MeV. The excitation of a resonance ~3 MeV wide in the continuum region at 18.25 ± .25 MeV of excitation energy in ^{40}Ca was observed at a bombarding energy of 115.4 MeV. Angular distributions for the excitation of levels observed at 3.73, 3.90, 4.48, 5.26, 5.62, 5.90, 6.29, 6.58, 6.94, 7.94, and 8.10 MeV of excitation energy in ^{40}Ca were obtained for laboratory scattering angles between 3.0 and 36.0°. The angular distributions were analyzed using the distorted wave Born approximation (DWBA) with macroscopic form factors. The extracted isoscalar transition rates show a slight but significant decrease with increasing bombarding energy when compared to previous work. The ^{40}Ca (α,α') isoscalar transition rates were found to be in agreement with previous (p,p') transition rates with the exception of the two lowest negative parity states. The 3^- level at 3.73 MeV and the 5^- level at 4.48 MeV have (p,p') rates in good agreement with the (α,α') rates at 30.1 MeV bombarding energy. Differential cross sections for the excitation of levels observed at 2.62, 3.22, 3.73, 4.09, 4.35 (doublet), 4.69, and 5.51 MeV of excitation energy in ^{208}Pb were obtained for laboratory scattering angles between 6 and 40°. The angular distributions were analyzed using the DWBA with macroscopic form factors. The interference between the Coulomb excitation and the nuclear excitation mechanisms was observed at small angles for the excitation of the 2^+ level at 4.09 MeV of excitation energy in ^{208}Pb. The DWBA calculation required 200 partial waves in order to accurately account for this interference. Furthermore, the data favored the assumption that $\beta_{Coulomb} = 1.2\ \beta_{nuclear}$. Differential cross sections for the excitation of the isoscalar resonance were obtained for laboratory scattering angles between 7 and 20°. The angular distribution was analyzed using the DWBA with macroscopic form factors. Although contributions from a monopole excitation cannot be ruled out, attributing all observed yields to a giant quadrupole resonance (GQR) exhausts only 30% of the energy-weighted sum rule. The lowest 2^+ and 3^- levels in ^{40}Ca and ^{208}Pb were analyzed using microscopic form factors. (Diss. Abstr. Int., B)

2093 THE FT VALUE FOR THE SUPERALLOWED FERMI DECAY $^{54}Co(\beta^+)^{54}Fe$. Hoath, S. D. (Oxford Univ. (UK). Nuclear Physics Lab.); Petty, R. J.; Freeman, J. M. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment); Squier, G. T. A.; Burcham, W. E. (Birmingham Univ. (UK). Dept. of Physics). Phys. Lett., B; 51: No. 4, 345-348(19 Aug 1974).

The threshold for the reaction $^{54}Fe(p,n)^{54}Co$ has been measured as 9192.4 ± 1.8 keV. The corresponding endpoint energy for the superallowed Fermi decay $^{54}Co(\beta^+)^{54}Fe$ is 7218.5 ± 1.8 keV. The half-life for ^{54}Co decay was found to be 193.0 ± 0.3 ms. The calculated "effective" ft value is in good agreement with those of ^{14}O, $^{26}Al^m$ and ^{34}Cl. (auth)

2094 INTERPRETATION OF INTERMEDIATE STRUCTURE IN THE ^{40}Ca NEUTRON ELASTIC SCATTERING CROSS SECTION. Kirouac, G. J.; Turinsky, P. J. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA). Dept. of Nuclear Science). Nucl. Phys., A; 228: No. 3, 445-460(19 Aug 1974).

The s-wave neutron scattering cross section for ^{40}Ca is reconstructed from published resonance parameters. Averages over energy intervals of varying size reveal the presence of intermediate structure below 1.2 MeV. The same structure appears at all angles in the differential scattering cross section. Monte Carlo sampling of the Porter–Thomas and Wigner distributions favors the interpretation of the structure as nonstatistical. A coupled-channels formalism is applied to investigate intermediate states in n + ^{40}Ca using the particle–vibrator coupling model. All parameters of the calculation are fixed a priori using other, nonneutron, experimental data. Various particle–vibrator configurations leading to $\frac{1}{2}^+$ resonances are examined. About two-thirds of the s-wave strength below 1.3 MeV is accounted for. (auth)

2095 NEUTRON SCATTERING FROM TITANIUM: COMPOUND AND DIRECT EFFECTS. Barnard, E.; Devilliers, J.; Reitmann, D. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)); Moldauer, P.; Smith, A.; Whalen, J. (Argonne National Lab., Ill. (USA)). Nucl. Phys., A; 229: No. 2, 189-203(2 Sep 1974).

Total neutron cross sections of natural titanium were determined from 0.1–1.5 MeV with resolutions of $\gtrsim$ 1.5 keV. Differential elastic and inelastic neutron scattering cross sections were measured from 0.3–1.5 MeV with resolutions of $\gtrsim$ 10 keV. The inelastic neutron excitation of states in ^{46}Ti(889 keV), ^{47}Ti(160 keV) and ^{49}Ti(984 keV) was observed. The energy-averaged behavior of the measured results was described in terms of spherical and ellipsoidal optical models and compound-nucleus and direct-reaction processes. The observed fluctuating cross sections were compared with the results of statistical R-matrix calculations based upon the optical model and known resonance statistics. The character of the compound-nucleus fluctuations was found to be strongly influenced by the ellipsoidal deformation of the target nucleus. This fact was used to improve the determination of optical model parameters. Furthermore, the statistical R-matrix calculations displayed an intermediate resonance structure consistent with experimental observation without recourse to additional reaction mechanisms. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 1719, 2073, 2126, 2143, 2150, and 2162.

2096 (BNWL-B-369) STATISTICAL ANALYSIS OF A DETERMINATION OF THE HALF LIFE OF KRYPTON-85. Johnston, J. W. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 24 Jul 1974. Contract AT(45-1)-1830. 53p. Dep. NTIS $5.45.

Data from 53 determinations of ^{85}Kr to ^{226}Ra ratios done over a 15-year long experiment to determine the half-life of ^{85}Kr (K_β) were analyzed. A number of least squares regression models were fitted to the data. The best fitting model produced a K_β of 10.715 years with a standard deviation of 0.008 years. An average half-life estimate, based on individual half-life estimates from 48 of the Kr/Ra ratios was also calculated to show the effect on the uncertainty of estimation. The average half-life method produced a K_β estimate of 10.714 years with a propagated standard deviation of 0.0565 years. The uncertainty associated with the regression estimate could have been reduced by greater care for consistency in

the ionization chamber set-up. It was found that use of a glass sample holder for the earlier determinations and a plastic sample holder for 11 of the later determinations increased the uncertainty but apparently did not bias the results. The broad fluctuation of counting times from determination to determination, caused by use of capacitors with different capacitance, also contributed to the less than optimum precision. It was also found that the temperature/pressure adjustment used had no significant effect on the results. That is, the ratios are not significantly different when calculated with or without the T/P correction. However, including the changes in the average T/P from determination to determination did produce a significant reduction in the uncertainty of estimation. (auth)

2097 (KFK-1943) BETA DECAY AND NUCLEAR STRUCTURE: ^{86}Rb. Appel, H.; Behrens, H.; Buerk, K.; Mueller, H. W.; Szybisz, L.; Wischhusen, R. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Experimentelle Kernphysik). Mar 1974. 46p. Dep. NTIS (US Sales Only) $5.50.

It was aimed to gain information on the nuclear structure of ^{86}Rb by investigation of the $2^- \rightarrow 2^+$ β transition. For this purpose the energy dependence of the $\beta\gamma$ angular correlation and the angle dependence of the $\beta\gamma$ circular polarization correlation were measured. A novel experimental set-up was used for the angular correlation measurement allowing a simultaneous determination of the anisotropy coefficients A_2 and A_4 under considerable reduction of systematical and statistical errors. For the polarization correlation measurement an unusual experimental arrangement was applied providing the possibility of simultaneous observation under four different angles. Employing additional data on shape factor measurements and energy dependent circular polarization correlations from other authors the nuclear structure of the 2^- state in ^{86}Rb and the 2^+ first excited state in ^{86}Sr were evaluated. For the latter purpose the unified model with weak coupling was chosen. (auth)

2098 LIFETIMES OF EXCITED STATES OF NUCLEI IN THE Ni–Zn REGION MEASURED WITH THE DELAYED COINCIDENCE METHOD. Roodbergen, S. Amsterdam; Vrije Univ. (1974). 90p.

Thesis.

Lifetimes of excited states of nuclei in the Ni–Zn region were measured with the delayed coincidence method. With this method, lifetimes greater than about 10^{-10}sec can be measured accurately. Delayed coincidence measurements on short living parent nuclei with half-lives down to about 30 sec were possible. The equipment used for the lifetime measurements is described. The systematic error in the lifetime measurements has been estimated to be smaller than 4%. The lifetime of positronium in the NE 111 plastic scintillator has been measured. Lifetime measurements on excited states of the nuclei ^{61,63}Ni, ^{60,62}Cu, ^{65,67}Zn and ^{65,66}Ga are presented. A so-called "in beam" delayed coincidence measurement on levels of ^{63,65}Zn, excited directly in a nuclear reaction, is described. A comparison of the measured lifetimes with available theoretical predictions is given. Transition probabilities, obtained from the measurements, were compared with the single particle estimates. The multipole character of the transitions is discussed. Results of theoretical descriptions of the investigated nuclei are mentioned, and calculated and measured values for the lifetimes involved are compared if possible. The occurrence of Cherenkov radiation in photomultiplier windows, irradiated by gamma rays, and its consequences for delayed coincidence time spectra are also discussed. (NL)

2099 ELASTIC AND INELASTIC ELECTRON SCATTERING AT 20 AND 60 eV FROM ATOMIC Cu. Williams, W.; Trajmar, S. (California Inst. of Tech., Pasadena). Phys. Rev. Lett.; 33: No. 4, 187-193(22 Jul 1974).

Normalized differential and integral electron-impact cross sections for elastic scattering and for the excitation of the $^2D_{3/2}$, $^2D_{5/2}$, and $^2P_{3/2,1/2}$ levels of atomic copper were determined at 20 and 60 eV. An unexpectedly large cross section was found for the excitation of the $^2P_{3/2,1/2}$ levels, which at certain angular and energy ranges surpasses the cross section for elastic scattering. The integral cross sections in units of 10^{-16} cm^2 are elastic, 91.0 and 59.0; $^2D_{3/2}$, 1.85 and 0.36; $^2D_{5/2}$, 1.26 and 0.26; $^2P_{3/2,1/2}$, 77.2 and 36.5, at 20 and 60 eV, respectively. (auth)

2100 STUDY ON THE ISOMERIC RATIO BY THERMAL NEUTRON ACTIVATION. Bak, H. I. (Seoul National Univ.). J. Korean Nucl. Soc.; 6: No. 2, 89-96(Jun 1974).

The cross-section ratios of the nuclear isomeric pairs ^{80}Br^{m,g}, ^{81}Se^{m,g}, ^{104}Rh^{m,g}, ^{116}In^{m,g} and ^{134}Cs^{m,g} through the radiative thermal neutron capture process were studied. The experimental values of these ratios obtained by the activation method were compared with the calculated ones deduced from the modified Huizenga-Vandenbosch method. Agreement between these values within 30% could be attained by controlling the spin cut-off parameter and gamma-ray multiplicity. (auth)

2101 GAMMA-RAY DECAY SCHEME OF ^{89}Sr FROM THE ^{89}Sr(d,pγ)^{89}Sr REACTION. de Voigt, M. J. A.; Boyd, R. N. (Rochester Univ., N. Y. (USA). Nuclear Structure Research Lab.). Nucl. Phys., A; 228: No. 2, 301-313(12 Aug 1974).

Gamma-ray decay modes for ten low-lying excited states in ^{89}Sr up to E_x = 3.76 MeV have been determined. Those for the E_x = 2.67, 3.13, 3.25, 3.39 and 3.76 MeV levels are previously unreported. Angular correlation experiments were performed to determine the spins $J = 3/2$ for the E_x = 2.45 and $J = 1/2$ for the 2.67 MeV levels. Several quadrupole/dipole amplitude mixing ratios are also reported. Electromagnetic decay properties of ^{89}Sr levels up to E_x = 2.67 MeV are calculated with previously reported particle–core coupling wave functions. Agreement with experimental data is good for the E_x = 2.00 and 2.67 MeV levels, but generally is not satisfactory for the other levels. (auth)

2102 ANALYSIS OF ^{76}Ge(^{16}O,^{14}C)^{78}Se REACTION IN TERMS OF EXACT-FINITE-RANGE COUPLED-CHANNEL BORN APPROXIMATION. Tamura, T.; Low, K. S.; Udagawa, T. (Texas Univ., Austin (USA). Center for Nuclear Studies). Phys. Lett., B; 51: No. 2, 116-118(22 Jul 1974).

It is shown that an exact finite-range CCBA calculation is feasible and does fit the data of ^{76}Ge(^{16}O,^{14}C)^{78}Se very well, while an exact finite-range DWBA calculation does so rather poorly. The calculation was performed by using a computer program, SATURN-MARS-2. (auth)

2103 ENERGY LEVELS OF ^{71}Ge FROM ^{71}Ga(p,nγ)^{71}Ge. Malan, J. G.; Barnard, E.; de Villiers, J. A. M.; van der Merwe, P. (Atomic Energy Board, Pelindaba, Pretoria (South Africa). Nucl. Phys., A; 227: No. 3, 399-420(29 Jul 1974).

Energy levels of ^{71}Ge were populated by the ^{71}Ga(p,n) reaction at proton energies between 1.72 and 2.96 MeV, and their decay was studied by both $\gamma-\gamma$ and $\gamma-$n coincidences. Spins were determined within the framework of the statistical theory from angular distributions of de-excitation γ-rays and from excitation strengths of levels derived from γ-ray intensities and branching. A level and decay scheme for ^{71}Ge up to an excitation of 1.3 MeV is presented. (auth)

2104 NUCLEAR DATA SHEETS FOR A = 73. Alvar, K. R. (Rutgers–The State Univ., New Brunswick, NJ). Nucl. Data Sheets; 13: No. 3, 305-335(Nov 1974).

The 1966 version of the Nuclear Data Sheets for A = 73 was revised on the basis of experimental data received before March 1, 1974. Experimental data, arguments for J^π assignments, and detailed level schemes are presented. Uncertainties and inconsistencies are noted throughout the Data Sheets. (auth)

2105 DELAYED–NEUTRON SPECTRA FOLLOWING DECAY OF ^{85}As AND ^{135}Sb. Franz, H.; Kratz, J.; Kratz, K.; Rudolph, W.; Herrmann, G. (Institut für Kernchemie der Universität Mainz, D–65 Mainz, Germany); Nuh, F.M.; Prussin, S.G.; Shihab–Eldin, A.A. Phys. Rev. Lett. 33: No. 14, 859-862 (30 Sept 1974).

The delayed–neutron spectra following decay of 2.05–sec ^{85}As and 1.7–sec ^{135}Sb are found to consist of a small number of discrete lines, and the fluctuations in the experimental spectra differ significantly from those calculated with a statistical model. The data indicate that the β–strength function for these decays contains narrow resonances in the energy range 5–8 MeV. (auth)

2106 OBSERVATION OF NUCLEAR TRANSPARENCY IN PROTON–NUCLEUS COLLISIONS AT 200 GeV. Jain, P.L.; Kazuno, M.; Thomas, G.; Girard, B. (High–Energy Experimental Laboratory, Department of Physics, State University of New York at Buffalo, Buffalo, New York 14214). Phys. Rev. Lett. 33: No. 11, 660-663 (9 Sept 1974).

Proton–nucleus interactions in nuclear emulsion from a 200–GeV proton beam at the National Accelerator Laboratory have been studied in terms of multiplicities and the angular distributions of shower particles. Low multiplicities observed in complex nuclei do not depend upon the size or the excitation of the target nuclei. Our experimental results are explained in terms of the energy–flux cascade model and not by intranuclear cascade models. (auth)

2107 STUDY OF THE MECHANISM AND SPECTROSCOPIC UTILIZATION OF THE REACTIONS WITH HELIUM IONS (α,α') AND (^{3}He,α). Bucurescu, D. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 25: No. 8, 919-949(1973). (In Rumanian).

The topics cover theoretical basis, experimental methods, analysis of 19.5 MeV alpha–particle scattering by the ^{63}Cu, ^{64}Ni, ^{65}Cu and ^{66}Zn nuclei, and analysis of the ^{86}Sr(^{3}He,α)^{85}Sr reaction. (auth)

2108 EXPERIMENTAL STUDY OF NUCLEAR ELECTRIC QUADRUPOLE SPLITTINGS OF ^{59}Co IN $Co(NH_3)_6Cl_3$. Reynhardt, E. C. (Univ. of South Africa, Pretoria). Can. J. Phys.; 52: No. 15, 1398-1404(1 Aug 1974).

The nuclear magnetic resonance of ^{59}Co in a single crystal of $Co(NH_3)_6Cl_3$ was investigated at room temperature at 15 kG. Observed quadrupolar perturbations were analyzed by the method of Volkoff for three orthogonal planes to yield five electric field gradient tensors. The cobalt sites associated with these tensors are nonequivalent. The quadrupole coupling constants and asymmetry parameters vary from 1.0 to 17.2 MHz and 0.10 to 0.57 respectively. One of the principal axes of each tensor is found to coincide with the crystallographic b axis of the monoclinic unit cell. (auth)

2109 MASS MEASUREMENTS OF THE UNSTABLE NUCLEI ^{72}Se, ^{82}Sr, ^{100}Pd, ^{118}Te, ^{128}Ba, AND ^{160}Er USING THE (p,t) REACTION. Debenham, P.; Falk, W. R.; Canty, M. (Univ. of Manitoba, Winnipeg). Can. J. Phys.; 52: No. 15, 1416-1420(1 Aug 1974).

The two-neutron separation energies (S_{2n}) for the lightest stable isotopes of the elements Se, Sr, Pd, Te, Ba, and Er were determined to within <28 keV by measuring the (p,t) reaction Q values. These S_{2n} values are all lower than previous estimates for β-decay energy systematics, by up to 400 keV. They fit, however, into the systematics of S_{2n}. (auth)

2110 THE REACTIONS ^{68,70}Zn(^{3}He,d)^{69,71}Ga AND LEVEL SYSTEMATICS OF THE ODD-MASS Ga ISOTOPES. Riccato, A.; David, P. (Bonn Univ. (F. R. Germany). Inst. fuer Strahlen- und Kernphysik). Nucl. Phys., A; 228: No. 3, 461-477(19 Aug 1974).

The reactions ^{68,70}Zn(^{3}He,d)^{69,71}Ga have been studied at E^a_{He} = 15 and 17 MeV, respectively, with a broad-range magnetic spectrograph and analyzed in terms of the distorted-wave Born approximation. Energies, spins, parities and spectroscopic factors of levels up to about 5 MeV excitation energy have been determined for each of the nuclei ^{69,71}Ga. Total strengths and centers of gravity for the proton single-particle states are presented. Information is obtained about the zinc nuclei ground-state configurations. The systematic trends of the level structure of the odd-mass nuclei ^{65,67,69,71}Ga are presented. (auth)

2111 DIFFRACTION SCATTERING OF α-PARTICLES FROM EVEN ISOTOPES OF Ni AT BACKWARD ANGLES. Cowley, A. A.; Cronje, P. M.; Heymann, G.; Mills, S. J.; van Staden, J. C. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Physical Research Lab.). Nucl. Phys., A; 229: No. 2, 256-268(2 Sep 1974).

Angular distributions have been measured at an incident energy of 32.3 MeV for α-particle elastic scattering from the even isotopes of Ni, as well as for inelastic scattering from the lowest 2^+ and 3^- states. The optical model and distorted-wave Born approximation theory give a reasonably good description of the experimental data, although systematic discrepancies are observed. In contrast with other results for ^{58}Ni, it was found that agreement could be obtained between calculated and experimental excitation functions at 178° in the energy region from 24.3 MeV to 32.3 MeV. (auth)

2112 THE L/K ELECTRON CAPTURE RATIO IN FIRST-FORBIDDEN ^{81m}Kr DECAY. Chew, W. M.; Xenoulis, A. C.; Fink, R. W. (Georgia Inst. of Tech., Atlanta (USA). School of Chemistry); Schima, F. J.; Mann, W. B. (National Bureau of Standards, Washington, D. C. (USA)). Nucl. Phys., A; 229: No. 1, 79-92 (26 Aug 1974).

The L/K electron capture (EC) ratio of ^{81m}Kr was measured to be 0.146 ± 0.005 by utilizing the wall-less, anticoincidence, multiwire proportional counter technique and a reactor-produced, mass separated ^{81m}Kr source. From this value, the Q_{EC} and log ft values were determined to be 305^{+35}_{-15} keV and 11.6, respectively, EC decay assumed only to the ground state. If there is 4% EC branching to a reported 276 keV level, Q_{EC} becomes 322^{+41}_{-11} keV, from which $(L/K)_{g.s.}$ = 0.144 ± 0.005, log ft = 11.6 for EC to the ground state, $(L/K)_{276}$ = 0.213 ± 0.005, and log ft = 11.4 for 4% feeding to the 276 keV level. In order to be confident of these results, an extensive systematic comparison of experimental and theoretical L/K ratios was made for both first-forbidden non-unique and unique transitions. From this comparison, a $^1/_2^+$ ground state assignment for ^{81}Kr is confirmed. (auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 2063, 2073, 2100, 2105, and 2122.

2113 (AD-779397) LEVEL STRUCTURE OF ^{93}Nb WITH THE ^{96}Mo(p,α)^{93}Nb REACTION. Final Report. Park, Y. S.; Jones, H. D.; Bainum, D. E. (Ballistic Research Labs., Aberdeen Proving Ground, Md. (USA)). Apr 1974. 43p. NTIS.

The testing of functions and capabilities of computer codes available for analyses of the data obtained in support of the neutron cross section program at this laboratory is given. Emphasis is placed on testing the capabilities and usefulness of the computer codes for studies of a specific type of nuclear reaction, that is, a three-nucleon transfer reaction. The (p,α) reaction was chosen as a sample case because the present scattering facilities in the charged-particle room are best suited for the detection of alpha particles with an optimum experimental resolution. The results and information gained from this analysis may be used directly in the analyses and interpretation of (α,n) reactions. (auth)

2114 (ANCR-1000-2) GAMMA-RAY SPECTRUM CATALOGUE: Ge(Li) AND Si(Li) SPECTROMETRY. Third Edition, Volume 2. Heath, R. L. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Mar 1974. Contract AT(10-1)-1375. vp. Dep. NTIS $25.00.

A new edition of the Gamma-Ray Spectrum Catalogue has been issued. This second volume is devoted to the presentation of experimental pulse-amplitude spectra obtained with Ge(Li) and Si(Li) spectrometers. As in the previous edition (IDO-16880) issued in 1964, this edition presents experimental spectra for over 300 individual radionuclides. The application of high-resolution gamma-ray spectrometry for quantitative isotopic analysis requires a precise knowledge of the energies and intensities of major gamma rays emitted in the decay of a given isotope. For this reason the catalogue effort included the development of techniques for the measurement of energies and intensities by using Ge(Li) spectrometry. The data presented for each nuclide includes tabulated experimental values for gamma-ray energies and intensities with associated experimental error. A brief description of experimental methods and equipment employed to obtain these data is presented together with tables of measured values of gamma rays adopted for energy calibration of the gamma-ray spectrometers used to obtain these data. (auth)

2115 (ANL/NDM-4) ^{90}Zr AND ^{92}Zr; NEUTRON TOTAL AND SCATTERING CROSS SECTIONS. Guenther, P.; Smith, A.; Whalen, J. (Argonne National Lab., Ill. (USA)). Jul 1974. Contract W-31-109-Eng-38. 46p. Dep. NTIS $5.50.

Total neutron cross sections of ^{90}Zr and ^{92}Zr were measured from 0.9 to 5.5 MeV and elastic and inelastic neutron scattering cross sections from 1.8 to 4.0 MeV. The inelastic neutron excitations of six states in ^{90}Zr and more than twelve in ^{92}Zr were observed. The experimental results formed the basis of an optical-statistical model interpretation including considerations of the [N-Z/A] and shell dependence of the optical potential and the effects of resonance width-fluctuation and interference. Comparisons of measured and calculated cross sections suggested new J^π assignments for a number of excited states. The experimental and calculational results were incorporated into a limited evaluated data file in the ENDF format including total and scattering cross sections to from 0.8 to 8.0 MeV. (auth)

2116 (BNL-19191) γ-RAYS FROM NEUTRON CAPTURE IN AND BETWEEN RESONANCES. Chrien, R. E. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 20p. (CONF-740920-12). Dep. NTIS $4.00.

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974).

Experiments on neutron capture γ-ray emission in and between resonances and the extent of their conformity to, or departure from, purely statistical assumptions are examined. Resonance capture with subsequent radiative transitions to discrete final states can be a powerful tool in nuclear spectroscopy, with the nonspecific character of the (n,γ) reaction leading to populating states of differing nuclear structure. Capture between resonances, however, is expected to be influenced by direct components. Capture γ-ray spectra obtained in the off-resonance region can be fitted with interfering resonance and background amplitude terms, and the direct component, extracted. Near neutron strength function peaks, especially near the 3s and 3p maxima, width correlations are clearly seen in resonance and resonance-averaged spectra. Valence transitions are shown to be inadequate to describe these correlations. (12 figures, 1 table) (auth)

2117 (GSI-73-6) GSI-SEMINAR WS 1971/72 AND SS 1972. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)). Apr 1973. 162p. (In German).

The lectures of the 5th and 6th Heavy-Ion Seminar of the GSI have been compiled in this report. It deals mainly with topics on heavy-ion physics. (GE)

2118 (KFK-2017) SPECTROSCOPIC INVESTIGATION OF THE ISOTONES ^{137}Nd AND ^{139}Sm. Nowicki, G. P. (Kernforschungszentrum Karlsruhe (F. R. Germany). Zyklotronlaboratorium). Jul 1974. 61p. (In German). Dep. NTIS (US Sales Only) $6.25.

Thesis. Submitted to Heidelberg Univ. (West Germany).

The nuclei ^{139}Sm, ^{137}Pm, and ^{137}Nd, produced via (α, xn) reactions, were studied by gamma-ray spectroscopic methods. For ^{139}Sm and ^{137}Nd partial level schemes were constructed from the observed prompt gamma rays. Furthermore, gamma rays following the beta decay of ^{137}Pm were measured to construct a detailed decay scheme. For both nuclei bands of collective levels with negative parity based on the low-lying $11/2^-$ isomeric levels were observed. An attempt is made to describe these bands with a model which takes into account of nonadiabatic effects. The results give evidence for a weak prolate deformation of ^{137}Nd and ^{139}Sm. (27 figures, 3 tables) (auth)

2119 NUCLEAR DATA SHEETS FOR A = 106. Bertrand, F. E. (Oak Ridge National Lab., TN). Nucl. Data Sheets; 13: No. 3, 397-442(Nov 1974).

The 1960 version of the Nuclear Data Sheets for A = 106 was revised on the basis of data received before June 1974. All literature containing nuclear structure data pertaining to A = 106 was reviewed and evaluated, this effort resulting in the use of ≈150 references. Nine nuclei, Mo, Tc, Ru, Rh, Pd, Ag, Cd, In, and Sn(?) are assigned as members of the mass chain. This A-chain is organized in four parts which appear in the following order: Drawings, Summary Sheets for all nuclei, Data Sheets (for some nuclei there are no separate Data Sheets), and References. (auth)

2120 DECAY OF THE $7/2^-$ ISOBARIC ANALOGUE RESONANCE IN ^{125}Sb. Boyd, R. N.; Arking, R.; Lombardi, J. C.; Robbins, A. B.; Yoshida, S. (Rutgers–The State Univ., New Brunswick, N. J. (USA). Dept. of Physics); Slater, D. C.; King, H. T.; Avida, R. (Stanford Univ., Calif. (USA). Dept. of Physics). Nucl. Phys., A; 228: No. 2, 253-271(12 Aug 1974).

Measurements have been made of the inelastic scattering of protons from ^{124}Sn to the 2_1^+ (1.13 MeV) excited collective state in the region of the $7/2^-$ (10.65 MeV) isobaric analogue resonance in ^{125}Sb. On- and off-resonance cross section and analyzing power angular distributions have been fitted using a combination of direct (distorted-wave Born-approximation) and resonance collision functions. Two fitting methods were used, the first of which assumes compound nuclear scattering to be negligible, and the second of which is independent of the compound scattering. The latter method indicates a significant enhancement of the compound nuclear scattering in the region of the resonance. Partial decay widths were extracted from the experiment, and spectroscopic amplitudes were calculated. These are compared to spectroscopic amplitudes calculated theoretically using a pairing interaction and quadrupole–quadrupole and octupole–octupole interactions. The single-particle energies used in this calculation were obtained by fitting the energies and spectroscopic factors of the ^{125}Sn spectrum. The levels of ^{125}Sn are reproduced quite well up to 3 MeV of excitation, and the theoretical spectroscopic amplitudes compare reasonably well with those extracted from experiment. (auth)

2121 RECOIL STUDY OF MULTINUCLEON TRANSFER REACTIONS: CAPTURE OF SIX CHARGES BY Nd TARGETS IN Ar INDUCED REACTIONS. Bimbot, R.; Gardes, D.; Hahn, R. L.; de Moras, Y.; Rivet, M. F. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Nucl. Phys., A; 228: No. 1, 85-111 (5 Aug 1974).

Multinucleon transfer reactions induced with Ar ions and involving the capture of six charges by the target have been studied. The targets were all the separated isotopes of Nd, and the observed nuclei were ^{149}Tb, ^{150}Dy, ^{151}Dy. The experimental technique involved the measurement of the cross sections, angular distributions, and recoil range at each recoil angle of the heavy residual nuclei. After transformation of the data into the c.m. system, the angular distributions appear to be peaked backwards, close to 180°. This observation suggests that the present reactions are of the same type as the multinucleon transfer reactions studied by other authors for which the angular distribution of the light fragment was peaked forward in the c.m. system. The energy distributions in the c.m. system were used to check the feasibility of various mechanisms which could lead to the production of the observed isotopes. Each mechanism was supposed to be a two-step process: the first step was the exchange, from the projectile to the target, of a number n of nucleons, leading to an excited intermediate nucleus; and the second step, the deexcitation of the intermediate nucleus by nuclear evaporation. This analysis indicates that the most probable mechanisms correspond to n close to 12 (6 protons and 6 neutrons), and to an excitation energy of about 60 MeV for the intermediate nucleus. The distribution of cross sections versus the number of nucleons gained by the target is also in accord with this reaction model. (auth)

2122 OBSERVATION OF ISOMERIC STATES AND BAND STRUCTURES IN ^{107}Cd. Hagemann, U.; Brinckmann, H. F.; Fromm, W. D.; Heiser, C.; Rotter, H. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Nucl. Phys., A; 228: No. 1, 112-124(5 Aug 1974).

The odd-mass nucleus ^{107}Cd was investigated in the reactions ^{105}Pd(α,2n)^{107}Cd, ^{107}Ag(d,2n)^{107}Cd and ^{107}Ag(p,n)^{107}Cd. The constructed level scheme is based on results obtained from singles γ-ray spectra and excitation functions, from the measurements of delayed γ-rays, of $\gamma-\gamma$ coincidences, of internal conversion electrons and of γ-ray angular distributions. Two new isomers were observed. The first one, interpreted as the $h_{11/2}$ neutron state at 845.6 keV, has a half-life of 67 ± 6 ns. This isomeric state is populated by a strong E2 cascade. Bands built on the other intrinsic states with spins and parities $5/2^+$ and $7/2^+$ are not strongly populated. For the second isomeric state at an excitation energy of 2679 keV a half-life of 55 ± 4 ns was determined. This isomer is probably a three-quasiparticle state. Its configuration can be proposed as $[\pi(g_{7/2})_{g^2}^2\ \nu(g_{7/2})^1]_{n_{1/2}+}$. (auth)

2123 THE QUADRUPOLE MOMENTS OF THE 5^- STATES IN ^{116}Sn, ^{118}Sn AND ^{120}Sn. Krien, K.; Klemme, B.; Folle, R.; Bodenstedt, E. (Bonn Univ. (F. R. Germany). Inst. fuer Strahlen- und Kernphysik). Nucl. Phys., A; 228: No. 1, 15-28(5 Aug 1974).

The quadrupole interaction frequencies $\omega_0 = 3eQ_1V_{zz}/4I(2I-1)$ in the 5^- state of ^{118}Sn have been measured by time-differential perturbed angular correlation technique in Sn, Sb and (95% Sn + 5% Sb) environments. The ω_0 for ^{116}Sn was determined in Sn environment only. With the help of the known electric field gradient of Sn in a Sn lattice, the quadrupole moments have been deduced as $Q(5^-, {}^{118}Sn) = \pm 0.10(4)$ b and $Q(5^-, {}^{116}Sn) = \pm 0.165(60)$ b. These values together with the known quadrupole moment of the analogous 5^- state in ^{120}Sn are interpreted in terms of the pure single-particle model. The data exhibit the expected strong systematic variation of Q_I with the number of particles in the $h_{11/2}$ subshell, which is being filled with 1, 3 and 5 neutrons in ^{116}Sn, ^{118}Sn, and ^{120}Sn, respectively. (auth)

2124 A STUDY OF THE PHOTONEUTRON CONTRIBUTION TO THE GIANT DIPOLE RESONANCE IN DOUBLY EVEN Mo ISOTOPES. Beil, H.; Bergere, R.; Carlos, P.; Lepretre, A.; de Miniac, A.; Veyssiere, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire). Nucl. Phys., A; 227: No. 3, 427-449(29 Jul 1974).

By using a variable, monochromatic photon beam, the partial photoneutron cross sections $\sigma(\gamma,n) + \sigma(\gamma,pn)$, $\sigma(\gamma,2n)$ and $\sigma(\gamma,3n)$ are determined in the region of the giant dipole resonance for the doubly even Mo isotopes ^{92}Mo, ^{94}Mo, ^{96}Mo, ^{98}Mo and ^{100}Mo. Measured integrated photoneutron cross sections are compared with available integrated photoproton cross sections as a function of A. Broadening of the giant dipole resonances as A increases is observed, in good agreement with the predictions of the dynamic collective model. A tentative study of some isospin splitting effects is also carried out. (auth)

2125 THE ELECTRON CAPTURE AND β^+ DECAY OF ^{132}Cs. Goverse, S. C.; Klein, J. C.; Kuijper, J.; Blok, J. (Vrije Universiteit, Amsterdam (Netherlands)). Nucl. Phys., A; 227: No. 3, 506-512(29 Jul 1974).

The electron capture and β^+ decay of ^{132}Cs have been investigated by means of a 4π internal source scintillation spectrometer. The L/K electron capture ratio and the K/β^+ ratio of the first-forbidden transition to the 668-keV level of ^{132}I have been measured: L/K = 0.136 ± 0.001 and K/β^+ = 54 ± 9. The value of Q_{EC} = 2.31 ± 0.03 MeV has been deduced from the K/β^+ ratio. The β^+ branching ratio has been measured to be (1.5 ± 0.2)%. (auth)

2126 PROPERTIES OF NUCLEAR LEVELS PHOTOEXCITED BY NEUTRON-CAPTURE γ-RAYS OF Ti AND Cu. Wolf, A.; Moreh, R.; Shahal, O. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). Nucl. Phys., A; 227: No. 2, 373-388(22 Jul 1974).

Neutron capture γ-rays of Ti and Cu have been used to photoexcite nuclear levels in the 5–8 MeV region in various nuclei. The spins, parities, and radiative widths of resonance levels in ^{65}Cu, ^{100}Mo, ^{118}Sn, ^{126}Te, ^{130}Te, ^{186}W and ^{209}Bi were measured. The spins of the resonance levels were obtained by angular distribution measurements; and the parities, by polarization measurements. The radiative widths were determined using nuclear self-absorption, temperature variation and absolute scattering cross section measurements. The total radiative widths were found to be of the same magnitude as those of neutron resonances, after applying a correction allowing for different excitation energies. Some E2/M1 mixing ratios of high-energy transitions were

obtained; the E2 widths were found to be of the same magnitude as those obtained in (n,γ) experiments. (auth)

2127 NEW INTERPRETATION OF THE CORIOLIS KINKING EFFECT IN ODD–EVEN NUCLEI. Giraud, B.; Jaffrin, A. (Service de Physique Théorique, Centre d'Etudes Nucléaires de Saclay, 91190 Gif–sur–Yvette, France). Phys. Rev. Lett. 33: No. 13, 787-790 (23 Sept 1974).

A description of the Coriolis kinking effect that occurs inside rotational bands of odd–even nuclei is obtained in terms of two distinct intrinsic states that are separately invariant under a unitarity transformation related to the operator $U=\exp(-i\pi J^2)$. (auth)

2128 BACKBENDING AND DECOUPLED BANDS IN ^{126,128}Ba. Flaum, C.; Cline, D. (Nuclear Structure Research Laboratory, University of Rochester, Rochester, New York 14627); Sunyar, A.W.; Kistner, O.C. Phys. Rev. Lett. 33: No. 16, 973-976 (14 Oct 1974).

We have observed in ^{126}Ba a $K=0^+$ rotational band, extending to $I=18^+$, exhibiting strong backbending above the 10^+ state, and probably branching up to a second 12^+ state. Another band with spins 7^-, 9^-, 11^-, 13^-, and 15^- was also seen. A similar negative–parity band was observed in ^{128}Ba. Coriolis calculations reproduce the negative–parity bands in ^{126,128}Ba and other nuclei; this result suggests that they are decoupled two–quasiparticle (qp) states. The crossing of similar decoupled positive–parity 2–qp band and the 0–qp band can explain the backbending and the two 12^+ states. (auth)

2129 DEEPLY BOUND HOLE STATES AS A GIANT–RESONANCE–LIKE PHENOMENON. van der Werf, S.Y.; Kooistra, B.R.; Hesselink, W.H.A.; Iachello, F.; Put, L.W.; Siemssen, R.H. (Kernfysisch Versneller Instituut, Groningen, The Netherlands). Phys. Rev. Lett. 33: No. 12, 712-715 (16 Sept 1974).

Giant–resonance–like peaks showing systematic variations with neutron number have been observed in the (d,t) reaction on the even–A tin isotopes. In the reaction ^{116}Sn(d,t)^{115}Sn a separation of the $g_{9/2}$ and $p_{1/2}$, $p_{3/2}$ neutron–hole components has been obtained. A calculation of the hole spectral function shows that shell effects play an important role in determining the spreading width. (auth)

2130 ANOMALOUS BEHAVIOR OF THE (p,n) ANALOG REACTION ON THE MOLYBDENUM ISOTOPES. Poppe, C.H.; Grimes, S.M.; Anderson, J.D.; Davis, J.C.; Dunlop, W.H.; Wong, C. (Lawrence Livermore Laboratory, Livermore, California 94550). Phys. Rev. Lett. 33: No. 14, 856-859 (30 Sept 1974).

Differential cross sections of the (p,n) reaction to the ground–state analogs of the stable Mo isotopes have been measured for proton energies between 16 and 26 MeV. The integrated cross sections deviate strongly from the linear dependence on N–Z predicted by the $\vec{t}\cdot\vec{T}$ form of the isovector interaction commonly used to describe quasielastic scattering. (auth)

2131 DECAY OF ^{106}Rh. Rathore, I. V. S.; Sharma, R. R.; Singh, B. P. (Univ. of Roorkee, India). Indian J. Pure Appl. Phys.; 12: No. 5, 391-392(May 1974).

The method of $\beta-\gamma-\gamma$ angular correlation is used for the study of the doublet at 1.1275 and 1.1333 MeV in ^{106}Pd from the decay of 30 sec ^{106}Rh. Branching of two β-groups to these levels is determined and the spin values are confirmed as 0^+ and 2^+ for the 1134 and 1128 keV levels. (auth)

2132 CALCULATION OF THE β^--ENERGY SPECTRUM OF RADIONUCLIDE MIXTURES. Akermann, L.; Hilsberg, J.; Schillinger, K. (Technische Univ., Dresden). Kernenergie; 17: No. 6, 173-175(Jun 1974). (In German).

For solving various problems in radiation protection it is necessary to know the total β^- spectrum of radionuclide mixtures of well-known composition. On the basis of the Fermi theory of β^- decay, the principles of calculating the β^- spectra of single nuclides and mixtures of radionuclides are given. They were applied to calculating the total β^- spectra of fission product mixtures produced in prompt thermal fission of ^{235}U. Calculations were made on the Soviet BESM-6 computer by using an Algol code. The most important results are presented graphically and discussed. (4 figures) (auth)

2133 CROSS SECTION MEASUREMENTS FOR THE ^{103}Rh (n,n')^{103m}Rh REACTION FROM 0.122 TO 14.74 MeV. Santry, D. C.; Butler, J. P. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys.; 52: No. 15, 1421-1428(1 Aug 1974).

Cross sections for the production of ^{103m}Rh were measured by the activation method. At energies below 5.3 MeV the neutron flux was measured with a calibrated neutron long counter, while at higher energies, measurements were made relative to the known cross section for the ^{32}S(n,p)^{32}P reaction. The shape of the Rh excitation curve is discussed in terms of known energy levels in ^{103}Rh. An effective cross section for a ^{235}U fission neutron spectrum calculated from the measured excitation curve is 724 ± 43 mb. (auth)

2134 DECAY SCHEME OF ^{104}Rh. Girgis, R. K. (Al-Mustansiriyah Univ., Baghdad); Al-Husseini, J.; El-Rawi, O.; Abdulla, A. A. Indian J. Pure Appl. Phys.; 12: No. 4, 290-295 (Apr 1974).

The gamma rays following the decay of ^{104m}Rh (4.4 min) and ^{104g}Rh (42 sec) were investigated using a Ge-Li detector. The gamma rays of 332.6, 460.5, 479.1, 488.5 and 497.8 keV were resolved. A decay scheme including all gamma rays resolved is proposed. A new proposed level scheme for ^{104}Pd is in agreement with previous work on the decay of ^{104}Rh and the decay of ^{104}Ag. It is also in agreement with the results of nuclear reaction investigations involving ^{104}Pd as a product nucleus. (auth)

2135 GAMMA RADIATIONS, NEUTRON INELASTIC SCATTERING CROSS SECTIONS, AND NUCLEAR STRUCTURE OF ^{92}Zr AND ^{94}Zr. Glasgow, G. P. Lexington, KY; Univ. of Kentucky (1974). 172p. University Microfilms Order No. 74-22,992. Thesis (Ph. D.).

The recent interest in the even-A Zr isotopes stems from their location in the important mass-90 region of the periodic table and from their use as materials in nuclear reactors. Using (n,n'γ) spectroscopy, the level schemes of ^{92}Zr and ^{94}Zr were measured to about 3.4 MeV. Pulsed protons from a 6 MeV Van de Graaff accelerator were used with the T(p,n)^{3}He reaction to produce neutrons for measuring the 90° gamma-ray production cross sections of these isotopes at 50 keV increments from 2.22 to 3.70 MeV. Angular distributions from 30 to 150° were measured for ^{92}Zr at 3.20 and 3.70 MeV and for ^{94}Zr at 3.10 MeV. The rapid rise in the gamma-ray yields above their thresholds, combined with a measurement of their energies to within 1 keV, accurately determined the level energies and decay schemes of the isotopes. A 35 cm^3 Ge(Li) detector and related electronics detected the gamma rays from the high quality mass-separated samples. Spins were assigned by comparing the gamma-ray angular distributions and neutron inelastic scattering cross sections inferred from their angle-integrated production cross sections to the distributions and cross sections predicted, for various spin assignments, by the Wolfenstein-Hauser-Feshbach model of the compound nucleus. These studies revealed 28 gamma rays, 15 of which are previously unreported, from the 20 levels of ^{94}Zr below 3361.2 keV. The newly discovered levels at 2507.6, 2698.0, 2825.2, and, tentatively, at 2859.8 keV were assigned respective spins of 3, 0, 2 or 3, and, tentatively, 5. The spin of the previously reported level at 2887.0 keV is limited to a value of 3 or less. The studies identified 50 transitions from ^{92}Zr, two of which are tentative, and 34 of which are previously unreported, from 26 levels through 3472.0 keV. Only one new level was discovered, at 2903 keV, with spin 0. The other level energies were previously reported, but the energies assigned in this study clarify several ambiguities in previous studies. Spins were also assigned to many of the levels of ^{92}Zr. Level decay branching ratios and the mixing ratios of the transitions in both isotopes also were measured. The level energies, transition energies, and branching ratios are compared to the previously reported existing values of these quantities. Neutron inelastic scattering cross sections inferred from this study agree with recently reported directly measured inelastic scattering cross sections at 2.75 MeV but compare less favorably to similar cross sections at 3.50 MeV. (Diss. Abstr. Int., B)

2136 VECTOR ANALYSING POWER OF (d,p) AND (d,t) REACTIONS ON ^{142}Nd AT 12.3 MeV. Basak, A. K.; Griffith, J. A. R.; Irshad, M.; Karban, O.; Ludwig, E. J.; Nelson, J. M.; Roman, S. (Birmingham Univ. (UK). Dept. of Physics). Nucl. Phys., A; 229: No. 2, 219-229(2 Sep 1974).

Angular distributions of the vector analyzing power of the (d,p) reaction leading to several states of the nucleus ^{143}Nd and of the (d,t) reaction leading to the ground state and 0.193 MeV state of the nucleus ^{142}Nd were measured at a deuteron energy of 12.3 MeV. The angular distributions exhibit a distinct j-dependence, and conventional distorted-waves calculations are able to account for most of the features of the results. Deuteron optical-model parameters for use in the DWBA calculations were obtained from analysis of the deuteron elastic scattering data taken simultaneously with the (d,p) and (d,t) reaction measurements. (auth)

2137 INTERPRETATION OF THE PROPERTIES OF THE ODD-MASS SILVER ISOTOPES IN THE FRAMEWORK OF THE MODELS OF De-SHALIT AND ALAGA. Civitarese, O.; Krmpotic, F. (La Plata Univ. Nacional (Argentina). Departamento de Fisica). Nucl. Phys., A; 229: No. 1, 133-140(26 Aug 1974).

The structure of the odd-mass silver nuclei is discussed in terms both of the De-Shalit weak-coupling model and of the Alaga model. It is shown that these models exhibit similar features as regards the negative-parity states. A detailed comparison with experiment is performed for ^{109}Ag. (auth)

2138 LOW LYING STATES OF ^{96}Tc. Doukellis, G.; McKenna, C.; Finlay, R.; Rapaport, J. (Ohio Univ., Athens (USA)); Kim, H. J. (Oak Ridge National Lab., Tenn. (USA)). Nucl. Phys., A; 229: No. 4, 47-60(26 Aug 1974).

The ^{96}Mo(p,n) and ^{96}Mo(p,nγ) reactions have been studied for proton energies between 3.8 and 5.5 MeV. Energy levels in ^{96}Tc up to 632 keV excitation energy have been determined. Possible spin and parity assignments are given for several levels based on the neutron enhancement and angular distributions observed on and off resonance of the $5/2^+$ isobaric analog state in ^{97}Tc, as well as the observed γ yields. The first excited state reported at 34 keV was found to be a close doublet only 0.8 keV apart. The observation of this doublet in the (p,n) reaction was used to determine the ground state Q-value Q = −3.760 ± 0.010 MeV. (auth)

2139 SYSTEMATICS OF l = 6 (d,p) TRANSITIONS IN N = 83 NUCLEI AND A UNIFIED-MODEL INTERPRETATION. Booth, W.; Wilson, S.; Ipson, S. S. (Bradford Univ. (UK)). Nucl. Phys., A; 229: No. 1, 61-71(26 Aug 1974).

The reactions ^{138}Ba, ^{140}Ce, ^{142}Nd, ^{144}Sm(d,p) have been studied at an incident deuteron energy of 19 MeV using the injector-tandem accelerator and the multichannel magnetic spectrograph at the University of Oxford. Two strong l = 6 transitions to $13/2^+$ states have been found in each of these nuclei. DWBA calculations have been made, and spectroscopic factors, deduced. A unified-model interpretation of these states is presented, and good agreement with the experimental data has been found. Excitation energies of other positive-parity states have been calculated and compared with existing experimental information. (auth)

2140 THE COLLECTIVE EXCITATION OF ^{103}Pd FOLLOWING (HEAVY ION, xn) REACTIONS. Grau, I. A.; Rickey, F. A.; Smith, G. J.; Simms, P. C.; Tesmer, J. R. (Purdue Univ., Lafayette, Ind. (USA)). Nucl. Phys., A; 229: No. 2, 346-364(2 Sep 1974).

The energy level structure of ^{103}Pd was studied using the reactions ^{100}Ru(α,nγ)^{103}Pd and ^{94}Zr(^{12}C,3nγ)^{103}Pd. The experiments included the measurement of γ-ray yield as a function of incident projectile energy, γ−γ coincidence measurements, γ-ray angular distributions, and γ-ray linear polarization measurements. Two ΔI = 2 bands built on the $7/2^+$ and $11/2^-$ intrinsic states were observed. The (^{12}C,3n) reaction was found to be much more effective than the (α,n) reaction in exciting these bands. A decay scheme is presented showing energies up to 6049 keV and spins up to $35/2$. Additional information relating to the coupling between the odd particle and the core is presented. (auth)

2141 STUDY OF (d,α) REACTIONS ON ^{94}Zr AND ^{96}Zr. Suzuki, K.; Kawa, J.; Okada, K. (Osaka Univ., Toyonaka (Japan). Dept. of Physics). Nucl. Phys., A; 228: No. 3, 513-523(19 Aug 1974).

The nuclear structure of ^{92}Y and ^{94}Y has been investigated by the (d,α) reaction on ^{94}Zr and ^{96}Zr with 11.5-MeV deuterons. Some new levels have been seen in ^{92}Y and ^{94}Y. The angular distributions for these levels have been measured. A zero-range DWBA analysis has been carried out for these distributions, and spin−parity assignments have been made for the new levels. (auth)

2142 COMPOUND NUCLEUS REACTIONS OF B WITH Ta AND Ag. Delagrange, H.; Hubert, F.; Fleury, A. (Bordeaux-1 Univ., 33 – Gradignan (France). Centre d'Etudes Nucleaires). Nucl. Phys., A; 228: No. 3, 397-414(19 Aug 1974).

Excitation functions and mean recoil ranges are reported for the formation of ^{188}Pt, ^{186}Ir, ^{185}Os in ^{10,11}B reactions with ^{181}Ta and for ^{113}Sr in ^{10,11}B reactions with $^{107-109}$Ag. The stacked foil technique was used. The results are indicative of a compound nucleus process. Mean recoil ranges are compared to theoretical calculations with corrections for multiple scattering. The agreement is satisfactory. Evaporation calculations were performed with a modified statistical model code, GROGI 2. A good fit is obtained with parameters derived from studies of nuclei at low excitation energies; no enhancement of the rate of γ-emission is needed. (auth)

2143 DELAYED-NEUTRON EMISSION FROM SHORT-LIVED Br AND I ISOTOPES. Kratz, K. L.; Herrmann, G. (Mainz Univ. (F. R. Germany). Inst. fuer Anorganische Chemie und Kernchemie). Nucl. Phys., A; 229: No. 1, 179-188(26 Aug 1974).

Rapid radiochemical separation techniques have been used to investigate the delayed-neutron emission from bromine and iodine isotopes produced by thermal-neutron-induced fission of ^{235}U. The nuclides 0.63-sec ^{91}Br, 0.26-sec ^{92}Br and 0.41-sec ^{145}I have been identified as delayed-neutron precursors. Relative neutron abundances of these and of the known precursors $^{87-90}$Br and $^{137-140}$I have been measured, and absolute neutron abundances and neutron emission probabilities have been deduced. The P_n values are discussed in a simple semiempirical picture. (auth)

2144 THE G-FACTORS OF SHORT-LIVED ISOMERIC STATES IN ^{108}Ag AND ^{110}Ag. Bertschat, H.; Leithaeuser, U.; Leitz, W.; Pleiter, F.; Recknagel, E.; Spellmeyer, B. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany). Bereich Kern- und Strahlenphysik). Nucl. Phys., A; 229: No. 1, 72-78(26 Aug 1974).

Short-lived isomeric states in ^{108}Ag and ^{110}Ag were populated by means of (p,n) and (d,p) reactions. The nuclear g-factors of these states were determined with the pulsed beam DPAD method to be g(^{108}Ag; 215 keV) = 1.294(6) and g(^{110}Ag; 119 keV) = 1.277(15). The results indicate a spin and parity $I^\pi = 2^+$ for ^{108}Ag and $I^\pi = 3^+$ for ^{110}Ag. (auth)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 2116, 2121, 2126, 2142, 2161, and 2222.

2145 DECAY STUDIES OF ISOTOPES AND NEW ISOMERS IN THE MASS CHAINS 162, 164, AND 166. de Boer, F. W. N. Amsterdam; Univ. Amsterdam (1974). 162p.

Thesis.

Decay studies on short-living isotopes and isomers in decay chains with A = 162, 164 and 166 are described. The investigated nuclei are in the deformed rare earth region. The isomers mentioned have been discovered in the present work. A survey is given of the experimental arrangements and methods used for the investigation. The decay of 6.77 min ^{166}Hf and the decays of two new isomers in ^{166}Lu with half-lives of 2.12 and 1.41 min in addition to the 2.65 ground state are described. Positron-gamma ray coincidence measurements yield a Q-value of 5480 ± 160 keV for the ^{166}Lu ground state decay. The decay of ^{166}Yb to ^{166}Tm is described. Only one gamma ray of 82.29 keV was found. The decay of an as yet unreported 5.1 min isomer in ^{164}Tm and the (75 min) ^{164}Yb → (2.0 min) ^{164}Tm → ^{164}Er decay chain are described. The decay of ^{162}Yb is also described, and the 44.7-keV gamma ray is found to be mainly an M1 transition, indicating that its initial and final levels are the 2^- and 1^- members of a K = 1 ground state rotational band. The decay properties of the 21.55 min ^{162}Tm ground state and a previously unreported 24.3 s isomeric state in ^{162}Tm are also discussed. The discrepancy of the experimental K/β^+ ratio with theoretical prediction might be explained by a large number of unobserved weak gamma rays besides the total of 315 stronger ones observed. A systematic survey is given of the level properties of the odd-odd and the even-even nuclei identified in the decay studies. (NL)

2146 RADIOACTIVE DECAY OF ^{165}Dy. Ardisson, G. (Departement de Chimie, Algiers). Radiochem. Radioanal. Lett.; 18: No. 6, 365-372(26 Sep 1974). (In French).

Radioactive decay of ^{165}Dy was reinvestigated by means of coaxial Ge(Li) detectors. Energies and intensities of fifty-five γ rays were measured, of which six are reported for the first time. A ^{165}Ho level scheme was constructed including a new level at 702.9 keV having $J^\pi = 5/2^-$. The $13/2^-$ level of the ground-state band was found to be fed at 345.9 keV. (2 figures, 1 table) (auth)

2147 ANALYSIS OF (PARTICLE,xn) REACTIONS ON TANTALUM AND GOLD. I. ^{181}Ta(α,xn) Excitation Functions up to 104 MeV and Equilibrium Statistical Model Analysis. Hermes, F.; Jasper, E. W.; Kurz, H. E.; Mayer-Kuckuk, T. (Bonn Univ. (F. R. Germany). Inst. fuer Strahlen- und Kernphysik). Nucl. Phys., A; 228: No. 1, 165-174(5 Aug 1974).

Excitation functions for the reactions ^{181}Ta(α,xn)$^{185-x}$Re (x = 2, . . . , 8) were obtained from measurements of the residual activity of stacked foils. The results were compared to equilibrium statistical model calculations using a Monte Carlo method. With a proper choice of the quantities entering into the calculations the excitation functions were satisfactorily reproduced except for the tails at higher energies. The same type of calculation was applied to the data measured by Rao and Yaffe in the reaction ^{181}Ta (p,xn)$^{182-x}$W, (x = 1, . . . , 6), and there also good agreement of measured and calculated excitation functions was obtained. (auth)

2148 ANALYSIS OF (PARTICLE, xn) REACTIONS ON TANTALUM AND GOLD. III. Excitation Functions of d-Induced Reactions on ^{181}Ta from 10 to 80 MeV and Equilibrium Statistical Analysis. Bisplinghoff, J.; Ernst, J.; Mayer-Kuckuk, T. (Bonn Univ. (F. R. Germany). Inst. fuer Strahlen- und Kernphysik); Jahn, P.; Mayer-Boericke, C. (Kernforschungsanlage Juelich

G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik). Nucl. Phys., A; 228: No. 1, 180-188(5 Aug 1974).

Excitation functions for the reactions (d,xn), x = 5–8, (d,p), (d,2p), (d,p4n), (d,α4n) and (d,α6n) on ^{181}Ta were observed by analyzing the residual γ-ray activity of stacked foils bombarded with 80-MeV deuterons. For comparison an equilibrium statistical model calculation was carried out with an improved ROULETTE program. The unusually good statistics of the Monte Carlo calculation clearly reveals typical discrepancies between theory and experiment, which are due to non-equilibrium processes. (auth)

2149 HEXADECAPOLE DEFORMATIONS IN W AND Os NUCLEI FROM PERTURBED ROTATIONAL BAND STRUCTURE. Bernthal, F.M.; Jeltema, B.D.; Boyno, J.S.; Khoo, T.L.; Warner, R.A. (Departments of Chemistry and Physics and Cyclotron Laboratory, Michigan State University, East Lansing, Michigan 48824). Phys. Rev. Lett. 33: No. 15, 915-918 (7 Oct 1974).

The spectroscopic data for even–parity rotational and intrinsic states in ^{181}W and ^{187}Os are shown to be incompatible with very large static nuclear hexadecapole deformations ($\epsilon_4 \simeq 0.2$) implied by conventional analysis of recent Coulomb excitation measurements of E4 transition moments in ^{182}W and ^{186,188}Os. (auth)

2150 ANGULAR–MOMENTUM EFFECTS ON CONTINUUM GAMMA RAYS FOLLOWING HEAVY–ION REACTIONS. Tjøm, P.O.; Stephens, F.S.; Diamond, R.M.; de Boer, J.; Meyerhof, W.E. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. Lett. 33: No. 10, 593-596 (2 Sept 1974).

The average number of continuum γ rays above 0.6 MeV has been measured for each several final products in the reactions p+^{165}Ho, ^{16}O+^{150}Sm, and ^{84}Kr+Se. This number ranges from 2 to 20 and is shown to correlate mainly with the average angular momentum leading to each product. (auth)

2151 AVERAGE MULTIPLICITY OF UNRESOLVED PHOTON CASCADES IN THE DE–EXCITATION OF HIGHLY EXCITED COMPOUND NUCLEI. der Mateosian, E.; Kistner, O.C.; Sunyar, A.W. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. Lett. 33: No. 10, 596-600 (2 Sept 1974).

Heavy ion (HI,χN) reactions leading to ^{158}Dy, ^{160,162,164}Er, and ^{170,172}Hf were studied in order to determine the average multiplicity of the unresolved photons underlying discrete spectra of rotational band transitions observed in rare–earth even–even nuclei. The average multiplicity is found to be small (6), independent (to the accuracy of this experiment) of the ground–state rotational band level in which the cascade terminates. (auth)

2152 HALF-LIFE OF THE 379.3 keV STATE OF ^{169}Tm. Bodenstedt, E.; Lopez-Garcia, A. R.; Martinez, J. A.; Mendoza-Zelis, L. A.; Caracoche, M. C. (Univ. Nacional de La Plata). Can. J. Phys.; 52: No. 16, 1567-1570(15 Aug 1974).

The half-life of the 379.3 keV state of ^{169}Tm was reinvestigated by the delayed coincidence technique. The result, $T_{\frac{1}{2}} = 49.8 \pm 1.5$ ns is about 40% larger than the result by Berlovich et al. which had been generally accepted in the literature. (auth)

2153 NONADIABATIC THEORY OF THE ROTATIONAL STATES OF ODD ATOMIC NUCLEI. Israilov, A. A.; Sharipov, Sh. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 3, 86-88(1974). (In Russian).

A Hamiltonian is given for the rotational part of the energy for odd nuclei. This expression contains independent variables determining the form of the nucleus. For odd nuclei the model is assumed to consist of a shell and a single external nucleon. Rotational energies are calculated for various spins and deformation parameters. Theoretical and experimental values of spins and rotational energies are tabulated and compared for the odd nuclei ^{183}Re and ^{161}Dy. (SJR)

2154 COLLECTIVE VIBRATIONS AND THE NATURE OF THE INTRINSIC FIELD. Hernandez, E. S. (Univ., Buenos Aires); Plastino, A. Lett. Nuovo Cim.; 11: No. 1, 75-79(7 Sep 1974).

It is pointed out that the computation of the residual matrix elements may be unnecessary. It is shown that the information to be gained from the knowledge or this residual matrix element is not needed in order to describe the most important details concerning the microscopic structure of vibrational states in deformed heavy nuclei. The nucleus dysprosium-164 is considered. (JFP)

2155 TRANSFER REACTIONS OF B WITH Ta. Hubert, F.; Delagrange, H.; Fleury, A. (Bordeaux-1 Univ., 33 – Gradignan (France). Centre d'Etudes Nucleaires). Nucl. Phys., A; 228: No. 3, 415-431(19 Aug 1974).

Excitation functions and mean recoil ranges are reported for the formation of ^{182}Os, ^{183}Re, ^{182}Re, ^{181}Re and ^{182}Ta in ^{10,11}B interactions with ^{181}Ta. The stacked foil technique was used. The results are indicative of formation through a transfer reaction. We have considered a nucleon group transfer mechanism in a surface interaction followed by deexcitation via nucleon emission from the excited intermediate. Thus, the energy dependence of recoils and cross sections of single-nucleon and multinucleon transfer products have been calculated and found in good agreement with experimental results. (auth)

2156 THE ^{186}W(n,γ)^{187}W REACTION AT 24 keV, HEXADECAPOLE DEFORMATIONS, AND FRAGMENTATION OF NILSSON MODEL STRENGTH. Casten, R. F.; Breitig, D.; Wasson, O. A.; Rimawi, K.; Chrien, R. E. (Brookhaven National Lab., Upton, N. Y. (USA)). Nucl. Phys., A; 228: No. 3, 493-512(19 Aug 1974).

The (n,γ) reaction at 24 keV and thermal neutron energies was performed on enriched samples of ^{186}W to determine specific spin–parity limitations on states in the 700–1600 keV energy region in ^{187}W. A number of these states are populated by some of the strongest transitions previously observed in the ^{186}W(d,p)^{187}W reaction. Comparison of the results of the two reactions yields information on the distribution and fragmentation of Nilsson single-quasi-particle strengths. As in the odd Hf nuclei and in ^{183,184}W, significant fragmentation of strength was observed in ^{187}W. The systematics of the fragmentation is presented, and it is shown that a substantial loss of strength occurs in ^{183,184}W but not in ^{179}Hf or ^{187}W. The fragmentation, and its unexpected systematics, are not explained by previously available calculations. It is proposed that large hexadecapole deformations may be important in understanding the fragmentation. Such shape components lead to single-particle energy shifts, enhanced ΔN = 2 and Coriolis mixing as well as other j-dependent effects that tend in the direction of the experimental results. Calculations are performed to illustrate these effects. (auth)

2157 DECAY OF ^{172}Tm: THE MIXING OF $K^\pi = 0^+$ AND 2^+ BANDS IN ^{172}Yb. Reich, C. W.; Greenwood, R. C.; Lokken, R. A. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Nucl. Phys., A; 228: No. 3, 365-381(19 Aug 1974).

The level scheme of ^{172}Yb has been studied from the decay of 63.6-h ^{172}Tm. Gamma-ray energy and intensity measurements were made using Ge(Li) spectrometers. Forty-eight γ-ray transitions, nine of them previously unreported, were observed. All of these have been incorporated into a ^{172}Yb level scheme consisting of 16 excited states. The previously reported "1119 keV" γ-ray is shown to be a doublet, with one member de-exciting the I, $K^\pi = 2,0^+$ state at 1117.8 keV and the other de-exciting the I, $K^\pi = 2,1^-$ octupole-vibrational state at 1198.5 keV. This observation, together with that of the additional γ-ray transitions, provides further information on the de-excitation of the ^{172}Yb levels. Attention is focused on the properties of the excited $K^\pi = 0^+$ bands at 1042 and 1404 keV and the $K^\pi = 2^+$ bands at 1465 and 1608 keV. A phenomenological five-band mixing analysis of the γ-ray branching-ratio data, involving these four bands and the ground-state band, has been carried out. Results of this analysis are presented for two different assumptions concerning the signs of certain of the matrix elements coupling the excited bands. Additional measurements which could help in choosing between these two alternatives are indicated. Interesting similarities in some of the properties of the two excited 2^+ bands are pointed out, and a qualitative explanation of them is given in terms of the Nilsson level diagram relevant to ^{172}Yb. (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 579, 1719, 2063, 2092, 2114, 2126, 2177, and 2222.

2158 (AD-779944) COMPTON SCATTERING BY K-SHELL ELECTRONS OF HEAVY ELEMENTS. Durham, H. J. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio (USA). School of Engineering). Mar 1974. 70p. (GNE/PH-74-4). NTIS $6.50.

Thesis.

A method for measuring the doubly differential cross section for Compton scattering is presented. The general shape of the doubly differential cross section distribution for 662-kev photons incident on gold is determined for a scatter angle of 90. The distribution exhibits a scattered peak which is wider than predicted by the Compton formula. The energy of the center of the peak is 25 kev higher than predicted for photons Compton defect. A large increase in the relative magnitude of the cross section distribution is observed at low scattered photon energies. (auth)

2159 (KHFTI-73-10, pp 81-83) LIGHT FRAGMENT PRODUCTION IN PROTON REACTIONS WITH HEAVY NUCLEI AT E_p = 1 GeV. Vorob'ev, A. A.; Vol'nin, E. N.; Seliverstov, D. M.;

Shesternev, A. P.; Alkhazov, G. D. (Inst. of Nuclear Physics, Leningrad). 1973. (In Russian).

The results of the energy spectra of ^{4,6}He, ^{7,8,10}Li, ^{7,8,10}Be, and ^{10,11,12}B, formed during the interaction of 1-GeV protons with Au nuclei, were reported. A magnetic flight mass spectrometer was used for measurement of the spectra. The basic parameters of the mass spectrometer were reported. (INIS)

2160 COULOMB EXCITATION AND DIRECT INELASTIC EFFECTS IN THE DECAY OF THE 5$^-$ ANALOG RESONANCE IN ^{209}Bi. Ramavataram, K. (Univ. Laval, Quebec); Ramavataram, S.; Davies, W. G.; Ferguson, A. J.; Fraser, J. S. Phys. Rev., C; 10: No. 2, 632-637(Aug 1974).

The excitation function and angular distributions of the protons from the 5$^-$ analog resonance excited in the ^{207}Pb(p,p$_1$)^{207}Pb* reaction were measured and compared with a resonance calculation that included contributions from the inelastic and Coulomb excitation of the nucleus by adding the appropriate distorted-wave Born-approximation scattering amplitude to the Breit–Wigner resonance term. The experimental results are well reproduced by these calculations. From the fits to the elastic and inelastic scattering data, the strength of the $(f_{\frac{5}{2}}^{-1}\, g_{\frac{9}{2}})$ neutron particle–hole component in the parent-state wave function was deduced and found to be in good agreement with the predictions of the shell model. The reduced transition rate B(2) associated with the collective ($\frac{1}{2}^-$–$\frac{5}{2}^-$) excitation in ^{207}Pb was extracted. (4 figures, 1 table) (auth)

2161 ANALYSIS OF (PARTICLE, xn) REACTIONS ON TANTALUM AND GOLD. II. ^{181}Ta, ^{197}Au(^{3}He,xn) Excitation Functions and Equilibrium Statistical Model Analysis. Hermes, F.; Jasper, E. W.; Kurz, H. E.; Mayer-Kuckuk, T. (Bonn Univ. (F. R. Germany). Inst. fuer Strahlen- und Kernphysik); Goudsmit, P. F. A.; Arnold, H. (Instituut voor Kernphysisch Onderzoek, Amsterdam (Netherlands)). Nucl. Phys., A; 228: No. 1, 175-179(5 Aug 1974).

Excitation functions for the reactions ^{197}Au(^{3}He,xn)$^{200-x}$Tl(x = 3, . . . , 7) and ^{181}Ta(^{3}He,xn)$^{184-x}$Re(x = 3, . . . , 7) were measured at bombarding energies up to 75 MeV. The data are compared to the results of an equilibrium statistical model calculation including angular momentum conservation and γ-ray competition. Satisfactory agreement was found except for the high-energy tails. (auth)

2162 STUDY OF THE TEMPERATURE EFFECT OF RESONANTLY SCATTERED CAPTURE γ-RAYS. Moreh, R.; Shahal, O.; Jacob, I. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). Nucl. Phys., A; 228: No. 1, 77-84(5 Aug 1974).

The temperature effect of resonantly scattered capture γ-rays was studied critically in the temperature range 4.2°K–520°K in ^{208}Pb and in the range 4.2°K–670°K in ^{62}Ni. The γ source was produced by thermal-neutron capture in iron; the energy of the γ line scattered by ^{208}Pb is 7.279 MeV and by ^{62}Ni is 7.646 MeV. The observed variation with temperature of the scattered intensity from Ni was found to be in good agreement with Lamb theory using a single Debye temperature, θ_D = 420°K, throughout the whole temperature range. In the case of Pb, the agreement with Lamb theory using θ_D = 104°K was not so good, and a deviation from theory was observed in the temperature range 30°K–70°K; this deviation is discussed. (auth)

2163 MAGNETIC MOMENT OF THE 10$^-$, 2.53 ms STATE IN ^{208}Bi MEASURED BY IN-BEAM NMR-PAD. Huebel, H.; Guenther, C.; Euler, K. (Bonn Univ. (F. R. Germany). Inst. fuer Strahlen- und Kernphysik); Braeuer, N.; Riegel, D. (Freie Univ. Berlin (F. R. Germany). Fachbereich Physik). Nucl. Phys., A; 227: No. 3, 421-426(29 Jul 1974).

The g-factor of the 10$^-$ isomeric state in ^{208}Bi has been measured by the method of inbeam NMR-PAD. From the experimental value, |g| = 0.2666(27), the magnetic moment of the $i_{\frac{13}{2}}$ neutron hole state is deduced. The result is compared with experimental values of neighboring nuclei and theoretical predictions. (auth)

2164 ELECTROEXCITATION OF GIANT MULTIPOLE RESONANCES IN ^{197}Au AND ^{208}Pb BETWEEN 5 AND 40 MeV EXCITATION ENERGY WITH 90–MeV ELECTRONS. Pitthan, R.; Buskirk, F.R.; Dally, E.B.; Dyer, J.N.; Maruyama, X.K. (Naval Postgraduate School, Monterey, California 93940). Phys. Rev. Lett. 33: No. 14, 849-852 (30 Sept 1974).

Inelastic electron scattering with 90–MeV electrons shows previously observed giant resonances at excitation energies of $63A^{-1/3}$ (E2), $81A^{-1/3}$ (E1), $105A^{-1/3}$ (E3), and $130A^{-1/3}$ MeV (E2). Distorted–wave–Born–approximation analysis of additional structure at $53A^{-1/3}$ and $195A^{-1/3}$ MeV suggests a monopole assignment. Transverse contributions to the E1 matrix element are compatible with an electric spin–flip. Differing widths of the respective resonances in the two nuclei are explained through dynamic deformation of Au. The reduced electric transition strengths B(EL) are given. (auth)

2165 ENERGY DEPENDENCE OF (p,t)-REACTION CROSS SECTIONS. Toki, H. (Osaka Univ., Toyonaka, Japan); Sano, M.; Orihara, H.; Ishizaki, Y. Lett. Nuovo Cim.; 11: No. 4, 293-297 (28 Sep 1974).

It is shown how the (p,t) reaction cross sections change with the incident energy. The calculations are done for the ^{206}Pb(p,t) reaction within the framework of the distorted-wave Born approximation. Angular distributions and cross sections are discussed. (JFP)

2166 PROPERTIES OF THE 77 keV LEVEL OF ^{197}Au. Young, L. E.; Brenn, R.; Sprouse, G. D. (State Univ. of New York, Stony Brook (USA). Dept. of Physics). Nucl. Phys., A; 229: No. 1, 157-161(26 Aug 1974).

The 77-keV level of ^{197}Au has been studied by Coulomb excitation with low-energy ^{16}O projectiles. The quantity $\epsilon B/(E2)\uparrow$ = 0.0231(17) was obtained. Coupled with the recent precision measurements of the lifetime and mixing ratio, the measurement determines α_{total} = 4.0(2), which is in agreement with theory if penetration effects are included for the hindered M1 transition. The penetration parameter γ = 1.8(3) was determined for this transition. (auth)

2167 NEGATIVE-PARITY STATES IN Pb ISOTOPES: G-FACTOR OF THE 480 NS, J$^\pi$ = 9$^-$ ISOMER IN ^{200}Pb. Lutter, R.; Haeusser, O.; Donahue, D. J.; Hershberger, R. L.; Riess, F. (Muenchen Univ. (F. R. Germany). Sektion Physik); Bohn, H.; Faestermann, T.; von Feilitzsch, F.; Loebner, K. E. G. (Technische Univ. Muenchen, Garching (F. R. Germany). Physik-Dept.). Nucl. Phys., A; 229: No. 2, 230-240(2 Sep 1974).

The g-factor of the 480-ns, 9$^-$ isomer at 2.237 MeV in ^{200}Pb was measured by the time-differential perturbed angular distribution method. The result, g = –0.0285 ± 0.0011 confirms the rather pure $(f_{\frac{5}{2}}^{-1} i_{13/2}^{-1})$ quasiparticle structure of this state. Half-lives of 480 ± 20 ns, 43 ± 3 ns and 42 ± 4 ns have been measured for the 2237-keV 9$^-$, 2154-keV 7$^-$ states in ^{200}Pb and 2208-keV state in ^{202}Pb, respectively; E2 transitions and g-factors of negative-parity states in even, neutron-deficient Pb isotopes are discussed. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 1593, 1634, 1994, 2073, 2074, 2114, 2133, and 2222.

2168 (ANL-8096, pp 13-23) NUCLEAR-STRUCTURE STUDIES OF THE ACTINIDE ELEMENTS AND NUCLEAR ATOMIC INTERACTIONS. Apr 1974.

In Chemistry Division annual report, July 1972–June 1973.

Proton single-particle states in ^{231}Pa, ^{241}Am, and ^{249}Bk were analyzed; shape parameters were obtained. Spectra observed in the reactions ^{236}U(d,p) and ^{249}Cf(d,t) at 12 MeV are shown. A Gaussian model of the residual n–n interaction was used to fit the splittings of the two-quasi-particle states in ^{236}U. Cross sections and spectroscopic factors for the (p,t) reaction on nuclei from ^{226}Ra to ^{248}Cm are tabulated. Reaction Q values for the first excited L = 0 transitions are smoothly varying functions of mass in U and Pu isotopes, unlike the Q values of the lowest L = 0 transitions. Q-value spectra comparing levels in ^{238}Pu observed by using (d,t) and (p,t) reactions are shown. The alpha spectrum from the decay of ^{251}Fm is given, and conversion coefficients are discussed. Decay schemes for alpha decay of ^{251}Fm and ^{254m}Es are presented. The splitting energies between the parallel and antiparallel coupled states in ^{250}Bk were measured. Decay schemes for electron-capture decay of ^{251}Es and ^{240}Am and alpha decay of ^{252}Es are presented. The method of correlated quasi particles is discussed, and extracted spectra of neutron single-particle energy levels of ^{235}U and ^{237}U as calculated with a pairing interaction and the generalized 0$^+$ particle–particle interaction are shown. Atomic-beam nuclear magnetic resonance measurements were made on ^{253}Es and ^{254m}Es; the calculated hyperfine structure of the ^{253}Es $^4I_{15/2}$ ground state is shown, and atomic and nuclear electromagnetic properties of Es are tabulated. K-electron shakeoff in beta decay is addressed. (15 figures, 3 tables) (RWR)

2169 (ANL-8096, pp 24-46) NUCLEAR FISSION AND REACTIONS. Apr 1974.

In Chemistry Division annual report, July 1972–June 1973.

The following topics are addressed in this section: measurements of fission-fragment mass and kinetic energy distributions from ^{230}Th to ^{254}Fm; fission-product mass distributions for spontaneous fission of ^{253}Es and ^{254}Fm and for thermal-neutron-induced fission of ^{251}Cf, ^{254}Es, and ^{255}Fm; neutron-emission functions for ^{254}Es(n,f) and ^{256}Fm(sf); theoretical static model of nuclear fission

based on deformed shell effects; spontaneous fission isomerism; mechanisms of high-energy nuclear reactions (including recoil properties of the radionuclides ^{18}F, ^{22}Na, ^{24}Na, and ^{28}Mg); thick-target cross sections for production of actinides by secondary reactions induced by 19-GeV electrons; and dependence of pulse height response of Si surface-barrier detectors on incident angle and bias voltage. (23 figures, 2 tables) (RWR)

2170 (FRNC-TH-487) STUDY OF THE CROSS SECTIONS CORRESPONDING TO REACTIONS BETWEEN RESONANCE NEUTRONS AND ^{239}Pu. Derrien, H. (Paris-11 Univ., 91 - Orsay (France)). 1973. 201p. (In French). Dep. NTIS (US Sales Only) $13.25.

Thesis.

The theory of the R matrix, which is the basis of formalisms used to analyze neutron cross sections in the resonance region, is reviewed together with the statistical properties of resonance parameters and the relations from which mean values can be obtained for these parameters. Time-of-flight techniques were used to measure total neutron cross sections and the fission cross sections for ^{239}Pu. The most important results concern S_0^+ and S_1^+ density functions ($S_0^+ = 1.3S_1^+$), mean radiative capture widths, and resonance fission widths. The large resonances observed in the cross sections correspond to a spin value of 0^+ and to large fission widths (2145 MeV); the fission occurring in these resonances is chiefly due to an open channel corresponding to the 0^+ transition state of the ground state rotational band. The mean fission width of the 1^+ state is considerably smaller (35.3 MeV). This width corresponds to fission below threshold due to the double octupole 1^+ vibrational state predicted by J. J. Griffin. The existence of an intermediate structure in the fission cross sections of the 1^+ channel was established from studies of the fluctuations in the 1^+ resonance fission widths over six energy intervals lying between 0 and 660 eV. This intermediate structure is explained in terms of a double maximum fission barrier occurring in the fission for values less than the 1^+ channel threshold. (FR)

2171 SOME ANGULAR DISTRIBUTIONS OF FISSION FRAGMENTS OBSERVED IN TERNARY FISSION INDUCED BY 540-MeV Fe ON URANIUM. Vater, P.; Becker, H. J.; Brandt, R. (Philipps Univ., Marburg, Ger.). Radiochem. Radioanal. Lett.; 19: No. 1, 87-94(13 Oct 1974).

Angular distributions of fission fragments originating from ternary fission in the reaction (U + 540-MeV Fe) were measured. Mica was used as fragment detector. The distribution of angles normal to the beam direction is peaked close to angular symmetry ($105°-120°-135°$), but about 50% of all events have quite a different angular distribution. The classification of ternary fission events into certain classes with specific angular distributions is discussed. (5 figures) (auth)

2172 ROLE OF INTEGRAL DATA IN NEUTRON CROSS-SECTION EVALUATION. Pazy, A. (Hebrew Univ., Jerusalem); Rakavy, G.; Reiss, I.; Wagschal, J. J.; Ya'ari, A.; Yeivin, Y. Nucl. Sci. Eng.; 55: No. 3, 280-295(Nov 1974).

An up-to-date, detailed, and rigorous presentation of a generalized least-squares procedure developed to improve neutron cross-section evaluations is given, based on direct cross-section measurements by means of integral data. Both discrete and continuous (energy-dependent) integral quantities are considered. Explicit expressions are derived for the best estimates of the cross sections in a continuous form, as well as in the multigroup approximation. The procedure is illustrated by results relating to the updated Los Alamos data on spherical metallic critical assemblies and the latest ENDF/B cross-section library. It is demonstrated that, by minor modifications of the ENDF/B cross sections, most of the experimental data can be reproduced within their quoted uncertainties. (2 figures, 7 tables) (auth)

2173 NEUTRON TOTAL CROSS SECTION OF AMERICIUM-243. Simpson, O. D. (Aerojet Nuclear Co., Idaho Falls, ID); Simpson, F. B.; Harvey, J. A.; Slaughter, G. G.; Benjamin, R. W.; Ahlfeld, C. E. Nucl. Sci. Eng.; 55: No. 3, 273-279(Nov 1974).

Neutron transmission measurements were made on two high-purity samples of ^{243}Am having inverse thicknesses of 1288.2 and 279.3 b/atom, respectively. Data were collected from 0.5 to 1000 eV by using the Oak Ridge Electron Linear Accelerator. High-resolution data were taken by using 10- and 30-ns bursts of 140-MeV electrons, 10-ns channel widths, and a flight path of 18.576 m. An average value of Γ_γ of 39 ± 1 MeV was determined from shape analysis of 24 resonances below 18 eV. Single-level Breit-Wigner resonance parameters were obtained from area analysis up to 250 eV. The average level spacing between resonances was found to be 0.68 ± 0.06 eV. An s-wave neutron strength function of $(0.96 \pm 0.10) \times 10^{-4}$ was determined from the resonance parameters. The resonance-absorption integral for neutrons with energies above 0.625 eV was determined to be 1810 ± 70 b from the resonance parameters. (4 figures, 3 tables) (auth)

2174 EXPERIMENTAL STUDY OF NEUTRON DEFICIENT Am ISOTOPES. Archer, J. K. College Station, TX; Texas A and M Univ. (1974). 166p. University Microfilms Order No. 74-21,172.

Thesis (Ph. D.).

Both the fission and alpha decay of recoils from the reactions of ^{237}Np with ^{3}He and ^{4}He ions and reactions of ^{230}Th with ^{10}B were studied. Dielectric detectors and in-flight decay techniques were used to search for fission activities with half-lives < 1 sec, while both dielectric detectors and semiconductor detectors were used to investigate the fission activities with half-lives ≥ 1 sec. Cross sections or upper limits to cross sections were established at values ≤ a few nb for the production of fission activities with half-lives of 1, 1.4, and 2.6 min in the $^{237}Np + {}^{4}He$ and the $^{230}Th + {}^{10}B$ reactions. The alpha decay of recoils from these reactions was studied for activities with lifetimes > 1 sec and < 1 hr. A 6.46 ± 0.03 MeV activity was observed with a half-life of 3.3 ± 0.1 min which was assigned to ^{234}Am. Comparison of the cross sections for the alpha and fission activities indicate that the previously reported 2.6 min fission activity associated with the decay of ^{234}Am may result from fission of ^{234}Pu following the electron capture decay of ^{234}Am. (Diss. Abstr. Int., B)

2175 COHERENT-SCATTERING AMPLITUDE OF ^{243}Am AND ^{244}Cm. Mueller, M. H.; Lander, G. H.; Reddy, J. F. (Argonne National Lab., IL). Acta Crystallogr., Sect. A; 30: No. 5, 667-671 (1 Sep 1974).

Neutron diffraction experiments were completed on $^{243}AmO_2$ and $^{244}Cm_2O_3$. The coherent-scattering amplitude of ^{243}Am, relative to a value of 0.58×10^{-12} for oxygen, is 0.76 (1) $\times 10^{-12}$ cm. The value for curium is $\sim 0.7 \times 10^{-12}$ cm, which cannot be determined accurately in this experiment because both C-type (cubic, a = 11.0 Å) and A-type (hexagonal, isostructural with La_2O_3) Cm_2O_3 are present in the sample. Some of the difficulties in performing neutron diffraction experiments on these radioactive isotopes, which exhibit self-heating and spontaneous fission, are discussed briefly. (auth)

2176 NONOBSERVANCE OF SPONTANEOUS FISSION IN KURCHATOVIUM AT BERKELEY. Druin, V. B.; Lobanov, Yu. V.; Nadcarni, D. M.; Kharitonov, Yu. P.; Korotkin, Yu. S.; Tret'yakova, S. P.; Krashonkin, V. I. Sov. At. Energy (Engl. Transl.); 35: No. 4, 946-948(Oct 1973).

Translated from At. Energ. (USSR); 35: No. 4, 279-280(Oct 1973).

A ^{246}Cm target with ^{242}Cm tracer was irradiated with a beam of 100-MeV ^{18}O ions at the JINR cyclotron. A tape recoil-atom collector transporter and phosphate glass fission-fragment detectors were used. Thirty-one tracks of fragments from spontaneous fission of product nuclei in the reaction were observed. A half-life of 3.2 ± 0.8 s was found for $^{259}104$. The partial cross section for production was measured to be 4×10^{-34} cm^2. From the ratio between the measured cross section derived from spontaneous fission and the estimated total cross section, a spontaneous fission fraction $SF/\alpha \approx 7\%$ was obtained. The authors feel that experimental results yield an unambiguous result concerning the synthesis of the new element. (1 figure) (RWR)

2177 CALCULATED GROUND-STATE PROPERTIES OF HEAVY NUCLEI. Moeller, P.; Nilsson, S. G.; Nix, J. R. (Los Alamos Scientific Lab., N. Mex. (USA)). Nucl. Phys., A; 229: No. 2, 292-319(2 Sep 1974).

Ground-state distortions and single-particle corrections are calculated for nuclei with $Z \geq 68$ and $N \geq 106$ by use of the macroscopic-microscopic method as developed by Strutinsky. The microscopic part is calculated primarily by use of the folded Yukawa single-particle potential. Its parameters are redetermined to fit actinide data. The modified oscillator potential is also used in some of the studies. Two methods for calculating the macroscopic energy are investigated. One is the droplet model of Myers and Swiatecki, and the other is a modified liquid-drop model in which the surface-energy term is modified to take into account the finite range of the nuclear force. Single-particle level diagrams for the folded Yukawa potential are also presented. They are plotted as functions of the distortion parameters ϵ, ϵ_4 and ϵ_6. Theoretical and experimental single-particle levels at the ground state for actinide nuclei are also compared. (auth)

2178 THE DECAY OF ^{235}U. Teoh, W.; Connor, R. D. (Manitoba Univ., Winnipeg (Canada). Dept. of Physics); Betts, R. H. (Manitoba Univ., Winnipeg (Canada). Dept. of Chemistry). Nucl. Phys., A; 228: No. 3, 432-444(19 Aug 1974).

Twenty-eight γ rays, ten of which are reported for the first time, have been observed in the decay of ^{235}U, and all have been placed in a revised level scheme for ^{231}Th. Three new levels at

390.27, 317.42 and 240.82 keV have been proposed, and the data are in accord with the results of coincidence studies. Reduced transition probabilities of inter-band γ-ray transition are calculated from the data and compared with theory, and an estimate of the intrinsic quadrupole moment, Q_0, has been computed. (auth)

Nuclear Theory

Refer also to abstracts 1601, 1655, 1788, 1857, 1922, 1958, 2032, 2033, 2063, 2168, 2169, and 2235.

2179 (AD-779942) BARNYARD III: A MOMENTS CODE FOR NEUTRON CROSS SECTION COLLAPSING WITH THE CDC 6600 COMPUTER. Husemann, R. C. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio (USA). School of Engineering). Mar 1974. 142p. (GNE/PH-74-6). NTIS $10.25.

Thesis.

Barnyard 3, a multigroup neutron cross section computer code, was developed to satisfy a need in the Air Force Institute of Technology Graduate Nuclear Effects Program for neutron cross sections for nuclear weapons problems. A 99 fine group energy structure covering the energy spectrum from 14.918 MeV to .4139 eV can be collapsed to 22 or fewer broad groups. The absorption, fission, removal, transport, and total cross sections are calculated for each broad group as are the average cosine of the scattering angle and group to group scatter transfer cross sections. The zero moment calculated by the code or a user provided flux is used to flux weight these cross sections. (auth)

2180 (GIFT-2/73) SPIN OF HEAVY SPHERICAL ODD–ODD NUCLEI. Navarro, J.; Sesma, J. (Grupo Interuniversitario de Fisica Teorica de Altas Energias (GIFT), Zaragoza (Spain)). 1973. 15p. INIS.

The angular momentum of the ground state of heavy spherical odd–odd is considered. The nonvalidity of the known empirical rules is pointed out. The explanation of the experimental data in terms of the j–j coupling shell model is discussed. (auth)

2181 (KHFTI-73-10, pp 7-9) RESONANCE SCATTERING THEORY OF PIONS BY NUCLEI. Kazarnovskii, M. V.; Stepanov, A. V. 1973. (In Russian).

The study of the scattering of pions on nuclei in the vicinity of the $\frac{3}{2}-\frac{3}{2}$ resonance makes it possible to obtain valuable information on the structure of the atomic nucleus and the character of the interaction of nucleon isobars Δ with nuclei. An approach to the theoretical analysis of the resonance scattering of pions on nuclei, analogous with some limitations to the examination of the resonance scattering of γ quanta in crystals (Moessbauer effect), was developed. The formalism developed was applied also to the case of scattering of pions with excitation of other nucleon resonances. The form of the lines of resonance scattering with excitation of long-lived resonance scattering was more sensitive to the structural characteristics of the nucleus than in the case of $\frac{3}{2}-\frac{3}{2}$ isobars. (tr-auth)

2182 (KHFTI-73-10, pp 10-14) PHASES OF MUTUAL SCATTERING OF THE LIGHTEST NUCLEI AT HIGH ENERGIES AND GENERALIZED LEVINSON THEOREM. Kukulin, V. I.; Korennoi, V. P.; Neudachin, V. G.; Obukhovskii, I. T.; Smirnov, Yu. F. (Inst. of Nuclear Physics, Moscow). 1973. (In Russian).

It was shown that because of the Pauli principle in nucleus–nucleus systems a large number of forbidden states arise which must be allowed for in the Levinson theorem. This leads to a slow decrease of the phase and differential elastic scattering cross section at high energies. A unique optical description was proposed for a series of systems of light elements at low and moderately high energies which makes it possible to extrapolate the phases and cross sections to high energies. It was shown that actual experiments at the present on elastic scattering of light nuclei at energies of 200 to 900 MeV yield exceptionally interesting information on the structure of many light nuclei. (tr-auth)

2183 (KHFTI-73-10, pp 31-33) CONNECTION BETWEEN GIANT DIPOLE RESONANCE PARAMETERS AND NUCLEAR DENSITY CHARACTERISTICS. Semenko, S. F. (Lebedev Inst. of Physics, Moscow). 1973. (In Russian).

It was shown that the average dipole energy depends on two parameters of nuclear density: the radius of the half-life and the thickeness of the surface layer and the fact that the constant density surfaces in the nucleus are not similar in form affects the character of the optical anisotropy of the nucleus. Comparison of the data on the giant resonance parameters with data on the nuclear density from experiments on electron scattering is helpful from the viewpoint of the phenomenological description of the nuclear structure. (INIS)

2184 POINT INTERACTION IN PHOTON SHADOWING. Schaffner, J. G.; Trefil, J. S. (Univ. of Virginia, Charlottesville). Phys. Rev., D; 10: No. 1, 353-356(1 Jul 1974).

It is shown that the inclusion of heavy vector mesons in the vector-meson-dominance picture of photon-nucleus interactions cannot explain the observed lack of shadowing. Hence it is concluded that the "point interaction" in photon interactions cannot be associated with the existence of heavy vector mesons. (auth)

2185 SPECTRAL DISTRIBUTIONS OF MIXED CONFIGURATIONS OF IDENTICAL NUCLEONS IN THE SENIORITY SCHEME. I. Generalized Seniority Scheme. Quesne, C.; Spitz, S. (Univ. Libre, Brussels). Ann. Phys. (N. Y.); 85: No. 1, 115-151(30 May 1974).

The procedure for calculating the centroid energies as well as the total and partial widths of the generalized seniority distributions of mixed configurations of identical nucleons is described. An extensive use of the quasispin formalism is made. In some particular cases, analytical formulas, some of which are new, are derived for the centroids and widths. Numerical calculations are performed in the nickel and tin isotopes. They show that although the admixtures with $|\Delta\nu| = 4$ should in many cases be relatively small, those with $|\Delta\nu| = 2$ should be very large, owing to the important contribution of the single-particle potential. (auth)

2186 NUCLEAR DROPLET MODEL FOR ARBITRARY SHAPES. Myers, W. D.; Swiatecki, W. J. (Univ. of California, Berkeley). Ann. Phys. (N.Y.); 84: No. 1-2, 186-210(15 May 1974).

The droplet model of nuclear masses and density distributions, introduced previously for spherical configurations, is generalized to arbitrary shapes. Equations in closed form are given for the neutron and proton density nonuniformities induced by the electric forces, and also for the dependence of the neutron skin thickness on position on the nuclear surface. The formulas for the corrections to the nuclear energy associated with these effects are derived and this leads to a droplet model atomic mass formula which is presented with a preliminary set of coefficients adjusted to nuclear ground state masses and fission barriers. (auth)

2187 DEVELOPMENT AND APPLICATION OF C. BLOCH'S THEORY OF NUCLEAR LEVEL DENSITY. Slavik, C. J. Albany, NY; State Univ. of New York (1974). 204p. University Microfilms Order No. 74-20,298.

Thesis (Ph. D.).

This presentation includes a rederivation of the important results of Bloch's theory together with a clear statement of the approximations that were made. A detailed discussion is given for three different systems of fermions: a system containing one type of particle and systems containing two types of particles with and without angular momentum. An examination, via numerical methods, of the convergence of the expansions used by Bloch in the solution of the saddle point equations is also given. Furthermore, a verification of the accuracy of the solutions is provided by extensive comparisons with the precise solutions. Finally, the formalism developed is applied to the study of several problems in the theory of nuclear level density. These include the following: A discussion of the distribution of levels over isospin, including comparisons between Bloch's theory, the Rosenzweig treatment, and the Gaussian approximation. A comparison between measured and calculated (using Bloch's theory with individual-particle levels obtained from the shell model) values of the average level spacing at the neutron binding energy for spherical nuclei with atomic mass values lying between A = 63 and A = 150 and near the double magic nucleus ^{208}Pb. A detailed discussion of the remainder term in the Euler–Maclaurin expansion for the sum over states in the level density formula of Rosenzweig. A derivation of the density of levels for the g-fold degenerate uniform model with angular momentum. The development of the level density for a simple schematic model that includes a diagonal pairing interaction. (Diss. Abstr. Int., B)

2188 THE DEMOCRATIC NUCLEAR INTERACTION IN RELATIVE S STATES. Zamick, L. (Rutgers–The State Univ., New Brunswick, N. J. (USA). Dept. of Physics). Phys. Lett., B; 51: No. 2, 113-115(22 Jul 1974).

A simple relative l = 0 interaction is obtained by setting all relative matrix elements of a given spin equal to each other. The nuclear matrix elements are nearly equal for this interaction and the standard l = 0 interactions such as the Kallio–Koltveit interaction, although the relative matrix elements are quite different. (auth)

2189 THE LINKED CLUSTER EXPANSION FOR TWO-BODY OPERATORS. McCarthy, R. J. (Indiana Univ., Bloomington (USA). Dept. of Physics). Phys. Lett., B; 51: No. 2, 123-124(22 Jul 1974).

It is argued that the usual Bethe–Goldstone wave function should be normalized before being used to calculate the effect of two-body correlations on expectation values of two-body operators. This normalization is related to specific linked cluster diagrams and is shown to be necessary for "pair number" conservation. (auth)

2190 EXCHANGE CONTRIBUTION IN COMPTON SCATTERING ON NUCLEI. Christillin, P.; Rosa-Clot, M. (Scuola Normale Superiore, Pisa (Italy)). Phys. Lett., B; 51: No. 2, 125-128(22 Jul 1974).

Low-energy theorems are used to determine the amplitude for Compton scattering on nuclei. Seagull terms coming from exchange forces are shown to give a sizeable contribution in the region below nucleon resonances. (auth)

2191 THE USE OF "NEW" PION OPTICAL POTENTIALS IN THE (p,π^+) AND (π^+,p) REACTIONS. Miller, G. A. (Carnegie-Mellon Univ., Pittsburgh, Pa. (USA). Dept. of Physics); Phatak, S. C. (Pittsburgh Univ., Pa. (USA). Dept. of Physics). Phys. Lett., B; 51: No. 2, 129-132(22 Jul 1974).

Pion optical potentials that are obtained from pi–nucleon collision matrices with non-divergent off-shell behavior are used in DWBA calculations of meson absorption and production cross sections. Reasonable agreement with the experimental data is then obtained. (auth)

2192 TWO-PHASE MODEL OF HADRONIC MATTER AND HIGH ENERGY NUCLEAR PRODUCTION. Fishbane, P. M.; Trefil, J. S. (Virginia Univ., Charlottesville (USA). Dept. of Physics). Phys. Lett., B; 51: No. 2, 139-142(22 Jul 1974).

Discussion of the high-energy interactions of particles with nuclei has been of increasing interest lately, partly because of the availability of new data, and partly because such interactions should shed new light on the dynamics of elementary hadronic collisions. The reason for this is that, if hadronic collisions occur within a time scale t_0, then because of time dilation effects the time for a hadron to traverse the nuclear radius becomes short compared to t_0 at sufficiently high energies. Thus multiple production on nuclear targets is in principle capable of giving information on hadronic processes which is not available through any other technique, since it allows one to probe the interaction of the hadronic matter with downstream nuclei in the period in which the final state is just being formed. This note presents a purely descriptive model of such space–time dynamics which the data (as well as esthetic requirements) suggest, and which is compelling in its simplicity. The model fits experimental data on nuclear multiparticle production. (NL)

2193 SELF-CONSISTENCY EFFECTS IN FINITE NUCLEI. Comins, H. N. (Flinders Univ. of South Australia, Bedford Park. School of Physical Sciences); Hewitt, R. G. L. (Sydney Univ. (Australia). Daily Telegraph Dept. of Theoretical Physics). Nucl. Phys., A; 228: No. 1, 141-152(5 Aug 1974).

A procedure is given for including self-consistency and other insertion effects implicitly in the expansion for the effective interaction for open-shell nuclei. Harmonic oscillator states are used as a basis for the Bloch–Horowitz–Brandow diagram series and for the intermediate states of the reaction matrix. The procedure requires the use of a modified form of the reaction matrix and modified single-particle energies. (auth)

2194 AN EXTENSION OF WONG'S THEORY FOR COMPLEX GENERATOR COORDINATES. Lathouwers, L. (Rijksuniversitair Centrum te Antwerpen (Belgium)). Nucl. Phys., A; 228: No. 1, 125-140(5 Aug 1974).

An extension of Wong's generator coordinate theory is presented in terms of a reciprocal basis. The new formalism permits the derivation of explicit conditions under which the solutions of the variational equation of Griffin, Hill and Wheeler are entire functions, or even elements of Bargmann's Hilbert space. The well-known extension to complex parameters in the Gaussian overlap approximation then appears as a special case. (auth)

2195 MONTE CARLO CALCULATION OF MULTIPLE SCATTERING EFFECTS IN THERMAL NEUTRON SCATTERING EXPERIMENTS. Copley, J. R. D. (Argonne National Lab., Ill. (USA)). Comput. Phys. Commun.; 7: No. 6, 289-317(Jun 1974).

In a thermal-neutron scattering experiment, the measured cross section includes both single- and multiple-scattering events. The former can be obtained from the measurements by subtracting an estimate for the latter, which is generally a smoother function of scattering angle and energy and thus can be calculated using an approximate scattering function. The program is adapted from that of Bischoff. Given a scattering function, the program tracks successive neutrons within the sample and/or sample container in a Monte Carlo fashion. At each scattering point, the response, within each time channel and for each detector, is calculated. A cut-off is imposed to avoid tracking neutrons indefinitely. Single- and multiple-scattering contributions for each time channel and for each angle are separately accumulated. (NL)

2196 A VERSION OF A NUCLEAR OPTICAL MODEL CODE FOR SMALL COMPUTERS DESIGNED TO RUN ON A PDP-15. Datta, S. K.; Thompson, W. J.; Elliott, D. O. (Kansas State Univ., Manhattan (USA). Dept. of Physics). Comput. Phys. Commun.; 7: No. 6, 343(Jun 1974).

This is a version of the program OPTICS (R. J. Eastgate, W. J. Thompson and R. A. Hardekopf, Computer Phys. Commun. 5(1973) 69) which has been modified to run on the PDP-15 computer. Restrictions on the complexity of the problem are the same as in the original program except that the maximum number of L values has been increased to 80 and the maximum number of radial mesh points has been increased to 400. (NL)

2197 SOLUTION OF THE GENERALIZED BRUECKNER–HARTREE–FOCK (BHF) EQUATIONS IN THE exp(S) FORMALISM. Zabolitzky, J. G. (Bochum Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Nucl. Phys., A; 228: No. 2, 272-284(12 Aug 1974).

The angular momentum reduction of the generalized BHF equations is performed, and the iterative schemes and numerical methods employed in the solution of the resulting set of equations are outlined. In addition, the treatment of the coupling terms to the Bethe–Faddeev equations is described. (auth)

2198 THE SOLUTION OF THE THREE-PARTICLE BETHE–FADDEEV EQUATION FOR FINITE NUCLEI. Zabolitzky, J. G. (Bochum Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Nucl. Phys., A; 228: No. 2, 285-300(12 Aug 1974).

The solution of the three-body equation obtained within the framework of the exp(S) formalism is described, and numerical results are given for Faddeev–Brueckner–Hartree–Fock (FBHF) calculations on the nuclei ^{4}He and ^{16}O. The convergence of the cluster expansion is discussed. (auth)

2199 STRENGTH FUNCTION FOR FISSION IN THE TWO HUMPED BARRIER MODEL. Back, B. B. (Niels Bohr Institute, Copenhagen (Denmark)). Nucl. Phys,, A; 228: No. 2, 323-332 (12 Aug 1974).

The strength function model developed by Bohr and Mottelson is generalized to a system with two classes of states as encountered in the actinide region. Expressions for the distribution of vibrational strength among the compound states are derived under simplifying assumptions, and the effect on the fission decay is investigated. (auth)

2200 A POSSIBLE APPROACH TO BREAKUP IN NUCLEAR REACTION CALCULATIONS. Schwager, J. (Tuebingen Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Phys. Lett., B; 51: No. 3, 229-231(5 Aug 1974).

It is proposed to use the multi-channel Kato identity for estimating breakup amplitudes when an approximate scattering wave function is known from a variational calculation. Lines of connection are drawn with more familiar expressions for the breakup amplitudes. (auth)

2201 ELASTICITY IN THE RESPONSE OF NUCLEI. Bertsch, G. F. (Michigan State Univ., East Lansing). Ann. Phys. (N. Y.); 86: No. 1, 138-146(Jul 1974).

From the RPA equations of motion, macroscopic equations for the vibrations of nuclei are derived. These equations imply the Tassie model of form factors and yield an energy for the quadrupole vibration 30% lower than the empirical. The modes are interpreted as the classical vibration of an elastic solid. (auth)

2202 NUCLEUS–NUCLEUS OPTICAL POTENTIAL USING A DENSITY–DEPENDENT TWO–BODY INTERACTION. Sinha, B. (Wheatstone Laboratory, King's College, London WC2R2LS, England). Phys. Rev. Lett. 33: No. 10, 600-602 (2 Sept 1974).

The nucleus–nucleus optical potential is calculated by using a density–dependent two–body effective interaction where the local density takes into account the contribution of both the projectile and the target densities. The results indicate that it is important to use such an interaction when the densities of the colliding nuclei overlap significantly. (auth)

2203 VELOCITY–DEPENDENT NUCLEAR FORCES AND WEBER'S ELECTRODYNAMICS. Pearson, J.M.; Kilambi, A. (Laboratoire de Physique Nucléaire, Département de Physique, Université de Montréal, Montréal, Canada). Am. J. Phys. 42: No. 11, 971-975 (Nov 1974).

It is pointed out that the p^2 forces of nuclear physics are structurally similar to the force postulated by Weber in pre–Maxwellian times to be acting between moving electric charges. A brief review of the essential features of the Weber force is accordingly presented, with

particular emphasis being placed on the fact that, although it is incorrect as a basis for electrodynamics, it nevertheless leads to the correct expressions for the force and torque acting between closed circuits. It is in this way that we can understand the quasi–electromagnetic character of certain effects that arise in nuclear scattering in the presence of velocity–dependent forces. (auth)

2204 MODEL INDEPENDENCE OF THE RELATIONSHIP BETWEEN INTRINSIC QUADRUPOLE MOMENTS AND TRANSITION MOMENTS OF INERTIA OF EVEN–EVEN NUCLEI. Mantri, A. N.; Sood, P. C. (Banaras Hindu Univ., India). Indian J. Pure Appl. Phys.; 12: No. 5, 377-381(May 1974).

The empirical relation between the intrinsic quadrupole moments and the transition moments of inertia of ground band levels in doubly even nuclei — said to be characteristic of the variable moment of inertia (VMI) model — is shown to be model-independent in the sense that any phenomenological model, which satisfactorily fits the level energies, will also reproduce this relation. Such a conclusion is shown to be derivable from the mathematical connection between the transition moments of inertia and the transition gamma energies. This conclusion is then verified through numerical calculations with three separate models, each having a significantly different spin variation of moments of inertia. Each model is found to satisfy the relation with practically the same proportionality constant. The role of such a relation in providing an estimate of as yet unmeasured lifetimes (transition probabilities) is pointed out. (auth)

2205 CORRELATIONS IN NUCLEI. de la Ripelle, F. (Inst. of Physics, Belgrade). Fizika (Zagreb); 6: No. 2, 77-90(Jul 1974).

The way in which the correlations in nuclei appear in the hyperspherical expansion method is discussed. Comparisons to other methods are given. The cases of the trinucleon system and the α particle are investigated. (auth)

2206 STATISTICAL MODEL OF NUCLEAR REACTIONS. Vladuca, G. (Univ., Bucharest). Stud. Cercet. Fiz.; 25: No. 9, 1115-1130(1973). (In Rumanian).

A statistical collision matrix U which may be used to calculate averages of observables over energy ranges containing many resonances and total widths is defined. The statistical properties of the parameters of U are defined and discussed by relating them to the statistics of R-matrix parameters. The influence of these statistical properties on observable cross sections is presented. (auth)

2207 POPULATION OF EXCITED ELECTRONIC LEVELS BY BETA DECAY, AND ITS INFLUENCE ON MOESSBAUER SOURCE SPECTRA. Hirst, L. L.; Stoehr, J.; Shenoy, G. K.; Kalvius, G. M. (Technische Univ., Munich). Phys. Rev. Lett.; 33: No. 4, 198-201(22 Jul 1974).

In a Moessbauer source experiment the β decay produces a large initial population of the excited electronic levels of the Moessbauer source atom. It is shown that this causes such excited levels to contribute more prominently in the source experiment than in the corresponding absorber experiment. These contributions can provide a particularly sensitive method for studying relaxation rates among the excited electronic levels. A detailed discussion and model calculations are given for dilute paramagnetic 4f impurities in a metal. (auth)

2208 INTRINSIC DISCONTINUITY AND THE POSSIBLE MICROSCOPIC FOUNDATION OF THE HIGH SPIN ANOMALY IN ROTATIONAL NUCLEAR STATES. Len, L. (Univ., Frankfurt am Main). Lett. Nuovo Cim.; 11: No. 1, 51-54(7 Sep 1974).

It is suggested that the existence of a microscopic discontinuity in the intrinsic state of a rotating system which follows naturally from the cranking model may serve as a possibility for the microscopic foundation of the high spin anomaly in rotational nuclei. (JFP)

2209 DWBA ANALYSIS OF HEAVY-ION TRANSFER REACTIONS. II. Anni, R.; Taffara, L. (Univ., Lecce, Italy). Nuovo Cim., 23A: No. 4, 691-702(21 Oct 1974).

In order to evaluate recoil effects approximately, the possibility of obtaining a series expansion in $\alpha = \mu_x/\mu_B$ of the DWBA matrix element for the transfer reaction $(a + x) + b \rightarrow (b + x) + a$ is discussed. It was found that an approximate but convergent series in α of the partial wave matrix element at fixed angular momenta can be obtained if both the contributions from small r_{bA} and large r_{ax} are discarded. The explicit expression of the N-th order in α is also given and the limit of applicability of such an expansion is discussed. (auth)

2210 DUAL PARTON MODEL AND THE REPULSIVE CORE OF NUCLEAR FORCES. Bandyopadhyay, P. (Indian Statistical Inst., Calcutta); Patari, K.; Das, A. Lett. Nuovo Cim.; 11: No. 4, 253-256(28 Sep 1974).

An attempt is made to explain the hard core as an antisymmetrization effect but with a dual-parton model of hadrons developed recently. It is found that although the basic mechanisms are the same as in the earlier attempts, due to the very nature of the model, some entirely different conclusions are reached which have both experimental support and encouraging overall simplicity. (JFP)

2211 EXPERIMENTAL REVELATION OF THE POSSIBLE HIDDEN PENETRATION EFFECT IN M1 INTERNAL-CONVERSION PROCESSES. Savic, I. (Univ., Belgrade); Krpic, D. K.; Anicin, I. V. Lett. Nuovo Cim.; 11: No. 4, 298-300(28 Sep 1974).

Results obtained using the Hager and Seltzer tables for the study of possible hidden penetration effect in M1 internal conversion processes are presented. It is found that the penetration effect is very pronounced for $p_{\frac{1}{2}}$ electrons and less for $s_{\frac{1}{2}}$ electrons. (JFP)

2212 A TWO-NUCLEUS SHELL MODEL WITH PAIRING FOR THE CALCULATION OF MOLECULAR HEAVY-ION OR FISSION POTENTIALS. Hasse, R. W. (Muenchen Univ. (F.R. Germany). Sektion Physik). Nucl. Phys., A; 229: No. 1, 141-156(26 Aug 1974).

The Hamiltonian of a system of two interacting nuclei close to each other is rewritten by using the dual (biorthogonal) basis of single-particle states of the non-interacting fragments. Equations similar to the usual BCS and gap equations and the interaction energy result from a variation with respect to the occupation numbers. As applications, these equations are solved approximately in order to study the change of the Fermi energies and pairing gaps with the distance between the two nuclei and to obtain the interaction potential of two ^{118}Pd nuclei numerically. In a simple model calculation the nuclear interaction energy close to contact cancels the Coulomb energy up to a constant; a flat potential in the fusion or fission direction which even may exhibit a barrier results. (auth)

2213 INTERACTION OF TWO-QUASIPARTICLE AND PHONON EXCITATIONS IN EVEN–EVEN ATOMIC NUCLEI. Vdovin, A. I.; Kyrchev, G.; Stoyanov, Ch. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 21: No. 1, 137-145(Oct 1974). (In Russian).

Possibility of describing the interaction of two-quasiparticle and phonon excitations in even-even nuclei in the framework of the semi-microscopic approach is considered. It is shown that this interaction essentially affects the structure of excited 1.5 to 2.5 MeV states in deformed and some spherical nuclei. Formulas are derived for the state energies and the wave function coefficients. (auth)

2214 MECHANISM OF DIRECT REACTIONS AT HIGH ENERGIES. Kolybasov, V. M.; Leksin, G. A.; Shapiro, I. S. (Inst. of Theoretical and Experimental Physics, Moscow). Usp. Fiz. Nauk; 113: No. 2, 239-284(Jun 1974). (In Russian).

On the basis of present experimental material an explanation is given of the state of knowledge on the physical nature and mechanism of direct nuclear reactions – processes in which the greater part of the energy and momentum of the incoming particle is transmitted to a single nucleon or to a small group of nucleons. It is explained why for studying the nature of direct reactions it is particularly fitting to use high-energy particles. The relation between nuclear physics and the physics of elementary particles is discussed. The theoretical principles of investigating direct reactions are presented. Particular attention is devoted to establishing the mechanism of direct reactions in the final state of which three or more particles are present. Detailed consideration is given to band and triangle Feynman diagrams, and also to an approximation method of taking into account the contribution of other diagrams. The following classes of reactions are considered: quasielastic processes, double charge exchange of pions, elastic pd scattering, the K^-d interaction, and nuclear capture of pions and kaons. Experimental data are analyzed and compared with theoretical results. Desirable directions of further experimental studies are indicated. (29 illustrations, 131 references) (SJR)

2215 THEORY OF TERNARY FISSION IN THE LIQUID DROP MODEL. Diehl, H.; Greiner, W. (Frankfurt Univ. (F.R. Germany). Inst. fuer Theoretische Physik). Nucl. Phys., A; 229: No. 1, 29-46(26 Aug 1974).

Within the framework of the liquid drop model the fissioning of a nucleus into three equal fragments is considered. Two different parametrizations for the prolate and oblate direct fission modes are calculated. Through a comparison of the prolate ternary and the binary potential energy surfaces, the ratio of the experimental ternary to binary fission yields is qualitatively explained. (auth)

2216 PARTICLE–HOLE AND PARTICLE–PARTICLE RPA GROUND STATE CORRELATIONS AND THE GREEN FUNCTION FORMALISM. Bouyssy, A.; Vinh Mau, N. (Paris-11 Univ., 91–Orsay (France). Inst. de Physique Nucleaire). Nucl. Phys., A; 229: No. 1, 1-14(26 Aug 1974).

Green's function techniques are used to derive the two-particle and particle–hole RPA correlations in the ground state of a closed-shell nucleus. The correlation energy and density are calculated with the Tabakin interaction for ^{16}O and ^{40}Ca and compared to the second-order perturbation theory contributions. The correlation energies are, respectively, –12.80 and –18.78 MeV for ^{16}O and ^{40}Ca. (auth)

2217 INVESTIGATION OF THE EXCITATION SPECTRUM OF AN EXACT NUCLEAR MODEL BY THE MCHF APPROXIMATION. Coelho, H. T.; Das, T. K. (Universidade Federal de Pernambuco, Recife (Brazil). Instituto de Fisica). Nucl. Phys., A; 229: No. 2, 320-332(2 Sep 1974).

The multiconfiguration Hartree–Fock (MCHF) method is applied to the exactly solvable model of Lipkin, Meshkov and Glick. The energy spectrum is investigated for truncation of the Hartree–Fock basis states in the weak-, intermediate- and strong-coupling regions. There is good agreement between the computed low-lying states and the exact ones, in the weak- and intermediate-coupling regions. But the low-lying spectrum is strongly modified in the strong-coupling region. An explanation is given for this behavior. The ground-state energy is found to be very well reproduced in all three regions. (auth)

2218 TIME-DEPENDENT MODULATION OF THE PROBABILITY AMPLITUDE OF SINGLE PHOTONS. Hauser, U.; Neuwirth, W.; Thesen, N. (Koeln Univ. (F.R. Germany). 1 Physikalisches Inst.). Phys. Lett., A; 49: No. 1, 57-58(12 Aug 1974).

In a Moessbauer experiment the probability amplitude of a photon is mechanically chopped like a square wave. The spectra excellently agree with a simple theory of pure, time-dependent amplitude modulation. (auth)

2219 EFFECTS OF EXCHANGE CURRENTS ON MUON CAPTURE. Ohta, K.; Wakamatsu, M. (Tokyo Univ. (Japan). Dept. of Physics). Phys. Lett., B; 51: No. 4, 337-340(19 Aug 1974).

It is shown that the one-pion exchange current renormalizes the axial and induced pseudoscalar form factors of the weak axial current. The effect decreases total muon capture rate about 13% and the branching ratio of radiative-to-ordinary muon capture rate about 12%. (auth)

2220 IMPACT PARAMETER REPRESENTATION FOR SEPARABLE POTENTIALS. Bhakar, B. S. (Manitoba Univ., Winnipeg (Canada). Dept. of Physics). Phys. Lett., B; 51: No. 4, 331-333(19 Aug 1974).

An exact impact parameter representation for nonlocal separable potential has been written down. This representation is valid at all angles and energies. Further, it is shown that the Blankenbecler–Goldberger representation follows naturally for such a potential and has also an N/D form. (auth)

2221 PCAC AND RENORMALIZATION OF THE WEAK AXIAL-VECTOR VERTEX IN NUCLEI. Ohta, K.; Wakamatsu, M. (Tokyo Univ. (Japan). Dept. of Physics). Phys. Lett., B; 51: No. 4, 325-328(19 Aug 1974).

A model proposed by Ericson et al., is reinvestigated and it is shown that the repulsive hard core in the nucleon–nucleon interaction modifies the weak axial form factor g_A as well as the pionic form factor g_r of the nucleons in nuclear matter. The renormalization of the induced pseudoscalar form factor h_A is also described. (auth)

2222 CALCULATION OF FISSION BARRIERS WITH THE DROPLET MODEL AND FOLDED YUKAWA SINGLE-PARTICLE POTENTIAL. Moeller, P.; Nix, J. R. (Los Alamos Scientific Lab., N. Mex. (USA)). Nucl. Phys., A; 229: No. 2, 269-291 (2 Sep 1974).

Single-particle levels in a folded Yukawa potential are studied as functions of various types of distortions. Some level diagrams are plotted versus an elongation coordinate in the fission direction. The levels are also plotted as functions of the asymmetric coordinate ϵ_{33}. The levels are labelled by their asymptotic quantum numbers. These diagrams thus show the calculated single-particle level structure at the second minimum and second peak in the fission barrier for nuclei in the actinide region. Fission barriers are calculated by use of the macroscopic–microscopic method; the macroscopic part of the energy is obtained from the droplet model of Myers and Swiatecki. The relevant equilibrium points in the fission barrier are tabulated for the actinide elements and also for some lighter elements in the region $76 \leq Z \leq 84$. The calculated energies of the equilibrium points reproduce experimental values to within an accuracy of 1 or 2 MeV. A detailed comparison is made between the three-quadratic-surface parametrization and the ϵ coordinates in Nilsson's perturbed-spheroid parametrization. (auth)

2223 LONGITUDINAL AND TRANSVERSE DISPERSION CORRECTIONS IN ELECTRON SCATTERING. Knoll, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Service de Physique Theorique); Rosenfelder, R. (Freiburg Univ. (F.R. Germany). Fakultaet fuer Physik). Nucl. Phys., A; 229: No. 2, 333-345(2 Sep 1974).

A previously developed eikonal approach to dispersion corrections in elastic electron scattering is generalized to include virtual transverse transitions. The second-order S-matrix is calculated in the external field representation of Feynman's perturbation theory and yields a gauge-invariant result. Numerical calculations for a simple nuclear model show that the virtual transverse excitations are not very important compared to the longitudinal contributions. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 710, 711, 725, 737, 821, 822, 845, 1587, and 1646.

2224 (AD-779941) EFFECT OF AN AIR/GROUND INTERFACE ON FLUENCE FROM A PLANE SOURCE OF NEUTRONS IN HOMOGENEOUS AIR. Fredrickson, F. N. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio (USA). School of Engineering). Mar 1974. 69p. (GNE/PH-74-5). NTIS $6.50.

Thesis.

A numerical approximation of the multigroup diffusion equation was used to evaluate fluence from a plane source of neutrons in a homogeneous air environment with an air/ground interface. Data from the air/ground model were compared with data from an infinite homogeneous air model to determine the effect of the air/ground interface on the total neutron fluence in the air. This simple model indicates that the ground acts as a neutron sink for all 22 neutron energy groups studied. Based on this result, a set of modifications to the AFIT nuclear survivability code was recommended to extend the useful range of that code below seven KM. (auth)

2225 (AD-780428) COMPUTATION OF THE RESIDUAL RADIATION TRANSMISSION FACTOR FOR THE MARINE CORPS LVTP7. Final report. Cawley, R. G. (Naval Ordnance Lab., White Oak, Md. (USA)). 28 Sep 1973. 52p. (NOLTR-73-137). NTIS $3.75.

The present work reports the results of an effort to compute the protection factor and the residual radiation transmission factor for the marine corps LVTP7 troop carrier in a field of radioactive fallout. The P7 is similar to another vehicle, the Army M113 APC (armored personnel carrier), for which experimental data are available, and the author has used those results in the method. Briefly, the author has developed an approximate analytical technique, which enables us to calculate the protection factor for an enclosure whose walls are composed of plane slabs having arbitrary orientations. (GRA)

2226 (BNWL-SA-4922) MEASUREMENT OF SPECIFIC ENERGY IMPARTED BY ELECTRONS. Braby, L. A.; Roesch, W. C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1974. Contract AT(45-1)-1830. 11p. (CONF-740715-12). Dep. NTIS $4.00.

From 5th international radiation research congress meeting; Seattle, Washington, USA (14 Jul 1974).

As a result of setting up a pulsed electron Van de Graaff for radiation biology experiments and related microdosimetry measurements, f(z,D) for a particular dose was measured directly and, thereby, it was reconfirmed that the approximation made in $f_1(z)$, the distribution in energy deposition in single events, does not distort calculated f(z,D) distributions. Specific energy distributions were measured using a modified multi-channel analyzer and a proportional counter. The method employed summed the signals from individual events until specified absorbed dose was reached. (MHR)

2227 (CONF-741018-, pp 259-266) DECAY SCHEME DATA FOR RADIATION DOSE CALCULATIONS. Mann, B. J. (Environmental Protection Agency, Las Vegas, NV). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population exposures.

Safety and environmental impact assessments of nuclear projects include calculations of expected radiation doses to individuals and population groups under a variety of circumstances. These calculations require detailed decay data from all individual radionuclides of interest. This data includes: half-lives or decay constants, decay modes and branching ratios, and energies and absolute intensities of all radiation emitted. A compilation of radiation energies and absolute intensities from the decay of radionuclides produced in light water power reactors has been initiated. This is primarily based on data provided by the Lawrence Berkeley Table of Isotopes Project and, to a lesser extent, on the publications of the Oak Ridge Nuclear Data Project. This effort has encountered a number of difficulties in development of a complete file of the best values for each of the decay parameters. These problems are discussed and data needs for dose computations are examined. It is proposed that a comprehensive, computerized decay data file be developed and maintained by a qualified group or organization. (auth)

2228 (GSF-B-437) DEPTH DOSE DETERMINATION IN A TISSUE-EQUIVALENT PHANTOM DURING IRRADIATION WITH FAST NEUTRONS. Mueller, A. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Frankfurt am Main (F. R. Germany). Abt. fuer Biophysikalische Strahlenforschung; Frankfurt Univ. (F. R. Germany)). Dec 1972. 62p. (In German).

Thesis.

Using paired ionization chambers, the dose vs. phantom depth has been determined. The curves are exponential in phantom depths >12 cm. The relaxation lengths for the dose depth pattern are smaller (by about 0.10) than the adequate values of the fluence which has been measured by means of a fission chamber. Agreement with literature data is unsatisfactory (different irradiation conditions). A comparison with theoretical values of Snyder shows a satisfactory agreement of the relative pattern of the neutron and the total dose (neutrons and γ-rays). For higher phantom depths, the γ-dose deviates from the calculations of Snyder to higher values. (GE)

2229 (UCID-15380) SPACE-AVERAGING OPACITY IN RADIATION DIFFUSION. Winslow, A. M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1968. Contract W-7405-eng-48. 7p. Dep. NTIS $4.00.

The radiation flux in the diffusion approximation is given by $F = (ac/3\kappa\rho)(d\phi/dx)$ where x is distance, κ opacity, ρ density, and $\phi = T^4$ with T = temperature. If mass coordinates $dm = \rho\, dx$, then the equation becomes $F = -\lambda(d\phi/dm)$, where $\lambda \equiv ac/3\kappa$. Methods of finding some suitable average of λ are discussed. (MHR)

2230 (UCID-15805) SCATTERED PHOTON SPECTRUM WITH AND WITHOUT FILTRATION FROM THE LRL 20,000 Ci ^{60}Co SOURCE. Clark, D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Jan 1971. 21p. Dep. NTIS $4.25.

A significant fraction of the 1.333 and 1.172 MeV gamma rays, emitted by a large ^{60}Co source, undergo one or more Compton collisions in the source material and the material around the source before escaping. These scattered gamma rays produce a continuous spectrum extending below 1.17 MeV. The gamma spectrum emitted by the LRL 20,000 Ci source was investigated by using an ~1 mc mockup of the large source and a NaI detector. Monte Carlo calculations were also run to obtain another check on the expected spectrum. Both investigations showed that ~50% of the emitted radiation is less than 1.17 MeV. Differential filtering was investigated as a technique to reduce the low-energy component of the emitted spectrum. (auth)

2231 (UR-3490-588) 14 MeV NEUTRON DOSIMETRY IN BIOLOGICAL MEDIA. Fearon, T. C. (Rochester Univ., N. Y. (USA). Dept. of Radiation Biology and Biophysics). 1974. 120p. Dep. NTIS $9.00.

Thesis.

Neutron energy spectra and fractional absorbed dose distributions in LET of a 14 MeV neutron beam have been obtained as a function of depth in a tissue equivalent liquid phantom. Threshold activation foils were used in the energy spectral determinations and a Rossi type proportional counter for the LET dose distributions. The effects of an inhomogeneity in the phantom were also examined. Results indicated a shift to lower energies in the neutron energy spectra as a function of depth in the phantom and behind a bone plastic plane interface. The absorbed dose distribution in LET showed modification mainly of the proton component with a decrease in the dose average LET. The interface led to an increase of the dose average LET. Taking advantage of the increased sensitivity of LiF due to recoil protons in a neutron irradiated biological medium ^{7}LiF (TLD-700) and ^{6}LiF (TLD-600) extruded rod dosimeters encapsulated in polyethylene were calibrated at depth in a tissue equivalent liquid phantom for in vivo 14 MeV neutron dosimetry. The neutron and gamma doses were determined with a paired chambers system (tissue equivalent and graphite chambers). The mean neutron energy at each position in the phantom was calculated from the neutron energy spectra obtained with threshold activation foils. The calibration resulted in neutron calibration factors for LiF dependent on the mean neutron energy which could be determined from the ratio of the response of TLD-700 to TLD-600. The calibrated TLD dosimeters were used to make in vivo dose and mean neutron energy measurements in the rat unilaterally exposed to 14 MeV neutrons. Measurements indicated differences in the dose and energy distribution in the intact animal as compared to a comparably sized rat phantom. (auth)

2232 (WAPD-TM-1012) GAMMA-RAY DOSE AND ENERGY ABSORPTION BUILD-UP FACTOR DATA FOR USE IN REACTOR SHIELD CALCULATIONS. Wallace, O. J. (Bettis Atomic Power Lab., Pittsburgh, Pa. (USA)). Jun 1974. Contract AT(36-1)-Gen-14. 58p. Dep. NTIS $6.00.

Tables of infinite medium gamma-ray dose and energy absorption build-up factors given in various references have been collected together. The data tables for beryllium, carbon, aluminum, iron, tin, tungsten, lead, uranium, water, ordinary concrete, magnetite concrete, and barytes concrete have been interpolated linearly on energy to give values at 31 energy levels in the range 0.25 to 10 MeV. Shorter tables are given for air, wood, sand, and lithium hydride. Parametric fit coefficients, which represent the build-up factors as smooth functions of optical distance, have been determined for all energies and materials included in this report. Taylor exponential fit coefficients are given except for those cases where both low energy and low atomic number occur simultaneously; under these conditions cubic and quartic polynomial fits were found to be more accurate. The accuracy of the parametric fits given here is generally better than 10 percent. Brief tables of dose build-up factor data obtained by linear and log–log interpolation of known data with respect to atomic number are included. (auth)

2233 STUDY OF THE IONIZATION OF ELECTRONS HAVING ENERGIES BETWEEN 50 AND 3000 MeV AND INVESTIGATIONS OF THE TSYTOVICH EFFECT. Virk, H. S. (Punjabi Univ., Patiala, India). Compt. Rend., Ser. B; 278: No. 8, 291-292(18 Feb 1974). (In French).

The ratio between the grain densities produced by ultra-relativistic electrons and those produced by 70-GeV protons is 1.007 ± 0.018. Experimental analysis did not reveal any reduction in electron energy losses on the Fermi plateau, contrary to the predictions of Tsytovich. (auth)

2234 VERSATILE SYSTEM FOR THREE-DIMENSIONAL RADIATION DOSE COMPUTATION AND DISPLAY, RTP. Weinkam, J.; Sterling, T. (Washington Univ., St. Louis). Comput. Programs Biomed.; 2: 178-191(Apr 1972).

The Radiation Treatment Planning System (RTP System) is designed to give the radiotherapist and radiophysicist maximum versatility in calculating and displaying dose distribution throughout the irradiated three-dimensional target volume of the patient. This system can compute dose distributions for treatment plans involving either fixed or moving beams. The fields may be arbitrarily located in space and the dose distribution may be corrected for curvature heterogeneity, wedges, compensators, or blocks. A variety of displays may be produced which enables the therapist to visualize the dose distributions and the various patient structures. Displays may be obtained in any desired plane or slice through the patient. The system is designed to easily interface with virtually any type of input/output device. In particular, the system is designed so that it may be used either interactively, by a user at a console such as a teletype or CRT terminal, or remotely, as an ordinary batch program. The RTP System is not limited to any particular source of ionizing radiation or specific method of calculation. In order to allow the use of any quality of radiation, the computing part of the system is in a separate module (as is true also for the other parts). At present the calculation for dose values is done through the equation developed by Sterling et al., which has been extended to cover the following ^{60}Co machines with acceptable accuracy: Eldorado A, Theratron F, Eldorado 8, and Theratron 80. Methods of calculation are being developed for other machines (especially linear accelerators) and will become available presently. (auth)

2235 MONTE CARLO PROGRAMS FOR CALCULATING THREE-DIMENSIONAL HIGH-ENERGY (50 MeV–500 GeV) HADRON CASCADES IN MATTER. Ranft, J.; Routti, J. T. (European Organization for Nuclear Research, Geneva (Switzerland)). Comput. Phys. Commun.; 7: No. 6, 327-342(Jun 1974).

High-energy protons incident on a target or a block of material initiate hadron cascades, which transport and deposit the energy of the interacting particles in matter. The resulting distributions of star densities and energy deposition are of interest in the analysis of accelerator radiation problems, background estimation for high-energy physics experiments, total absorption detectors, cosmic-ray transport, shielding for space vehicles, and activation of material in space. Monte Carlo simulation with particle splitting and variance reduction methods are used. Protons, neutrons and charged and neutral pions are considered, and empirical production formulas are used. (NL)

2236 INTERPRETATION OF ELECTRON CHANNELING BY THE DYNAMICAL THEORY OF ELECTRON DIFFRACTION. Kambe, K.; Lehmpfuhl, G. (Max-Planck-Gesellschaft zur Foerderung der Wissenschaften e.V., Berlin (F. R. Germany). Fritz-Haber-Institut); Fujimoto, F. (Tokyo Univ. (Japan). Coll. of General Education). Z. Naturforsch., A.; 29: No. 7, 1034-1044 (Jul 1974).

9 figs.; 22 refs.

The connection between electron channeling and electron diffraction is discussed on the basis of the dynamical theory. Results of the many-beam calculations for 50 keV to 2 MeV electrons incident almost parallel to a [110] axis of a MgO crystal are used as examples. Bloch waves with a marked concentration of electron density at rows of atoms are obtained, and interpreted as states of electrons bound to the rows of atoms, corresponding to the classical picture of channeling. This can be shown properly by applying the tight-binding method of band theory in the two dimensions perpendicular to the axis. In this picture the "rosette motions" in the classical theory are interpreted as p-type, d-type, etc. Bloch waves, and the "weavons" as loosely-bound s-type Bloch waves. They are connected to the pictures of the Borrmann effect and the Bloch-wave channeling in the diffraction theory. (auth)

2237 INELASTIC ENERGY LOSS OF AN ION BEAM. Zyabrev, A.F.; Sotnikov, V.M. (Moscow Engineering–Physics Institute). Sov. Phys.–Solid State 16: No. 2, 289-293 (Aug 1974).

The Monte Carlo method was used in a computer calculation of the inelastic energy loss of argon ions at energies of 10, 30 and 50 keV in thin surface layers of a molybdenum single crystal and a polycrystalline molybdenum target for incidence of the primary beam on the (001) face. The incidence angle of the ions was changed to correspond to the rotation of the target around the (010) axis. The inelastic loss was calculated on the basis of the statistical model for the excitation of electron shells in the binary–collision approximation. Useful information about the ion–crystal interaction can be extracted from a study of the effect of successive collisions experienced by the ions in the crystal lattice on the nonmonotonic dependences of the inelastic energy loss and the kinetic ion- electron emission yield on the incidence angle of the beam. Analysis of the angular dependences obtained with an account of the energy loss in layers of different thicknesses shows that the deep layers largely govern the deviation of the curves from monotonic behavior. There is a discussion of the contribution of collisions involving different energy losses to the formation of the emission minima corresponding to the main crystal axes, and there is a discussion of the possibility of a change in the shape of the secondary–electron spectra due to a change in the shape of the inelastic–loss spectra corresponding to a change in the incidence angle of the beam. (auth)

2238 BOUND ELECTRON STATES IN THE WAKE OF SWIFT IONS IN SOLIDS. Neelavathi, V. N. (Oak Ridge National Lab., TN); Ritchie, R. H.; Brandt, W. Phys. Rev. Lett.; 33: No. 5, 302-305(29 Jul 1974).

Fluctuations of valence-electron density are expected to occur in the wake of a fast charged particle moving through condensed matter. Electrons can be trapped into wake-riding states by the potential minima associated with domains of electron-density depletion with binding energies ranging from ~10 eV behind protons to several hundred eV behind highly charged heavy ions. Observable phenomena possibly linked to wake-riding states are discussed. (auth)

2239 SOLUTIONS OF THE TIME-DEPENDENT RECTILINEAR TRANSPORT EQUATION. Dawn, T. Y.; Yang, C. M. (National Tsing Hua Univ., Hsinchu, Taiwan). Nucl. Sci. J. (Taiwan); 11: No. 2, 57-72(Jun 1974).

Based on the simple rod model assumption, the time dependent semi-infinite and finite rectilinear transport problems are considered. The modified Riemann's method is used to solve the time dependent rectilinear transport equation in semi-infinite case. The solution will become that of an infinite case when the back scattering particles from boundary have not yet reached the observing point. Time dependent particle density distributions in finite case are derived with the aid of Laplace Transformation. After about three times of time required by a particle to travel along the segment without collisions, the exact solutions can be expressed as the form of eigenfunction expansions from which some symmetric properties and asymptotic solutions are studied. As the critical condition is satisfied, the asymptotic solutions are reduced to the steady state one. The decay constant from this work is compared with the result expected from diffusion theory as well as from transport theory. (auth)

2240 COMPUTER PROGRAM FOR INTRACAVITARY DOSE PLANNING. Beckman, K. W. (Regionjukhuset, Orebro, Sweden). Acta Radiol., Suppl.; No. 310, 39-47(1971).

A program has been developed which calculates dose distributions in arbitrarily chosen planes around an afterloading application. The program is written in BASIC for use on a Honeywell Bull time-sharing terminal. It makes it easy to obtain dose distributions with high accuracy with a minimum of input data and

the output is demonstrated either as a normalized distribution or a dose rate distribution in a matrix with a scale 1:1. (auth)

2241 APPLICATION OF THE IMPACT PARAMETER METHOD TO THE CHANNELED ION ENERGY DISTRIBUTION CALCULATION. Bulgakov, Yu. V.; Shulga, V. I. (Moskovskij Gosudarstvennyj Univ. (USSR). Inst. Yadernoj Fiziki). Phys. Lett., A; 48: No. 6, 429-430(29 Jul 1974).

Based upon an empirical dependence relating inelastic energy losses to the impact parameter of ion-atom collisions, a calculation of the energy distribution of He ions channeled in Si was made. (auth)

Radiation Protection Standards

Refer also to abstracts 712, 713, 821, and 2604.

2242 (CONF-741018-, pp 17-22) CONSIDERATION OF BACKGROUND IN DEVELOPMENT OF ENVIRONMENTAL STANDARDS. Moghissi, A. A.; Carter, M. W. (Georgia Inst. of Tech., Atlanta). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population exposures.

Environmental standards for a class of or for individual pollutants are usually derived from animal and human biological effects and kinetics data and/or in comparison with background levels. Once such standards are adopted they are applied to the entire nation without considering the significant differences in background levels in various geographical locations. Fallacies of this approach are identified and described using the example of environmental radiation standards. (auth)

2243 RADIATION CONTROL FOR HEALTH AND SAFETY. Hearings Before the Committee on Commerce, United States Senate. Ninety-Third Congress, First Session, on Public Law 90-602, March 8, 9, and 12, 1973. Washington, DC; Committee on Commerce (1973). 475p. GPO.

Radiation Source Calibration and Standardization

2244 (CONF-741018-, pp 99-102) ENFORCEMENT OF THE FEDERAL PERFORMANCE STANDARD FOR DIAGNOSTIC X-RAY SYSTEMS. Britain, R. G.; Leggett, I. P. Jr.; Barone, G. J. (Bureau of Radiological Health, Rockville, MD). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population exposures.

The Federal Performance Standard for Diagnostic X-ray Systems became effective on August 1, 1974. The enforcement of this Standard is the responsibility of the Food and Drug Administration's Bureau of Radiological Health. Enforcement activities include technical reviews of required reports from manufacturers and assemblers, inspector's visits to plants, import control through the United States Customs, laboratory tests on selected samples, and filed testing of installed certified x-ray systems. A description of these enforcement activities and their present status is presented as well as a brief discussion of the major requirements of the Standard. Cooperation between State Radiological Health Programs and the Food and Drug Administration is discussed in relation to field testing of installed systems. (auth)

Shielding Calculations and Experiments

Refer also to abstract 1326.

PHYSICS (THEORETICAL)

General

Refer also to abstracts 1603, 1663, and 2654.

2245 PARTICULAR SOLUTIONS OF THE INDEFINITE EQUATIONS OF MECHANICS FOR RIEMANNIAN MANIFOLDS WITH MOTION GROUPS. Morosi, C. (Milan Politecnico). Rend. Ist. Lombardo Sci. Lett., A; 107: No. 2, 270-282(1973). (In Italian).

Necessary congruence conditions in tensor form are obtained for Riemannian manifolds with groups of motion. If these conditions are known, it is shown how one can determine particular solutions of the indefinite equations of mechanics without field forces; the two problems of congruence and integration are given in an explicit form for the cases of a membrane upon a rotation surface, a particular three dimensional continuum and particular four-manifolds of a space-time continuum. (IAA)

2246 HAMILTON FORM OF THE FEYNMAN PATH INTEGRAL. Alimov, A. L. (Leningrad State Univ.). Teor. Mat. Fiz.; 20: No. 3, 302-307(Sep 1974). (In Russian).

Representation of a certain class of functions on operators in a form of the Feynman path integral is obtained. Generalization of this construction to a case of noncommuting operators is given. (auth)

2247 WHY THE ENERGY FLUX AND ABRAHAM'S PHOTON MOMENTUM ARE MACROSCOPICALLY SUBSTITUTED FOR THE MOMENTUM DENSITY AND MINKOWSKI'S PHOTON MOMENTUM. Costa de Beauregard, O. (Institut Henri Poincare, Paris). Lett. Nuovo Cim.; 10: No. 18, 852-854(31 Aug 1974).

The problem of Minkowski's vs. Abraham's photon momentum is considered. A general mathematical statement based on the relativistically expressed conservation of the six-component angular-momentum tensor and the use of an asymmetric energy-momentum tensor is presented. This statement is applied to the case of the Maxwell-Minkowski tensor. (LBS)

2248 POWER SPECTRUM OF THE NEUTRINO SEA. Rebuttal to Kuchowicz. Ruderfer, M. (Dimensions, Inc., Hempstead, NY). Lett. Nuovo Cim.; 10: No. 18, 826-828 (31 Aug 1974).

It was previously suggested that special relativity does not preclude the applicability of Bose-Einstein statistics to the neutrino sea. An attempt is made to clarify this suggestion as a rebuttal to a disagreement by Kuchowicz. Remarks are made on the factors involved in predicting the power spectrum of any gas. (LBS)

2249 EQUIVALENCE OF ELECTRIC CHARGE AND ENERGY. Balcytis, A. (Politechnical Inst., Kaunas). Lett. Nuovo Cim.; 10: No. 18, 835-836(31 Aug 1974).

It is pointed out that the equivalence law of electric charge and energy was introduced prior to Whitmire's letter (Lett. Nuov. Cimento; 7,305(1973)). It is also pointed out that the formula of Whitmire and the previously derived formula are identical and express the same equivalence principle of electric charge and energy. (LBS)

2250 KINETIC EQUATIONS FOR NONEQUILIBRIUM QUANTUM SYSTEMS. Balabanyan, G. O. (AN SSSR, Moscow). Phys. Lett., A; 48: No. 4, 275-276(1 Jul 1974).

Kinetic equations for nonequilibrium quantum systems for spatial homogenous case are received. Quantum systems with pair interaction and electron-impurity system are discussed. Higher order on interaction are taken into account. (auth)

2251 ONE-DIMENSIONAL CLASSICAL ELECTRON GAS. Kunz, H. (Ecole Polytechnique Federale, Lausanne, Switzerland). Ann. Phys. (N. Y.); 85: No. 2, 303-335(Jun 1974).

Equilibrium states of the one-dimensional classical electron gas are considered in detail. It is proved that this system is in a crystalline state, at all temperatures and densities. (auth)

2252 LOCALITY AND LATTICE THEORY. Solov'ev, M. A. (Inst. of Theoretical and Experimental Physics, Moscow). Teor. Mat. Fiz.; 20: No. 3, 299-301(Sep 1974). (In Russian).

The concept of localizability of a field is analyzed in terms of the lattice theory. (auth)

2253 OBSERVABLES OF THE DIRAC PARTICLE EXPRESSED IN A MANIFESTLY COVARIANT WAY. Hanus, W.; Slominski, J. (Univ., Torun, Poland). Rep. Math. Phys.; 4: 153-160(1973).

A manifestly covariant, quantum-mechanical Hamiltonian formalism (previously proposed) is applied to the homogeneous Dirac equation, in order to define the orbital, spin, and total angular momenta of the relevant particle as simple bivectors of spacelike character in the Minkowski space. The complete consistent scheme of covariant observables of the Dirac particle is obtained in this way after some additional considerations. A close correspondence between this formulation and the traditional noncovariant one is maintained. (auth)

2254 OPERATIONAL FOUNDATION OF QUANTUM LOGIC. Mittelstaedt, P.; Stachow, E. W. (Univ., Cologne). Found. Phys.; 4: No. 3, 355-365(Sep 1974).

The logic of quantum mechanical propositions — called quantum logic — is constructed on the basis of the operational foundation of logic. Some obvious modifications of the operational method, which come from the incommensurability of the quantum mechanical propositions, lead to the effective quantum logic. It is shown that in the framework of a calculation of this effective quantum logic the negation of a proposition is uniquely defined and that a weak form of the quasimodular law can be derived. Taking account of the definiteness of truth values for quantum mechanical propositions, the calculus of full quantum logic can be derived. This calculus represents an orthocomplemented quasimodular lattice which has as a model the lattice of subspaces of Hilbert space. (auth)

2255 FOUNDATIONS OF QUANTUM THEORY. Part II. Krips, H. (Melbourne Univ., Parkville, Australia). Found. Phys.; 4: No. 3, 381-394(Sep 1974).

The axioms for the density operator in quantum mechanics are discussed. A comparison is made with an axiomatization based on Gleason's theorem. (auth)

2256 MODIFIED EULER EQUATION FOR THE CORRELATION FUNCTION IN THE CASE OF A MANY-FERMION SYSTEM AND STUDY OF ITS ASYMPTOTIC BEHAVIOR. Grypeos, M. E. (Univ. of Thessaloniki, Greece); Mavrommatis, E. Lett. Nuovo Cim.; 11: No. 1, 61-68(7 Sep 1974).

A modified Euler equation is given and studied for the case of a many-fermion system. This is interesting because of the possibility of obtaining under certain conditions an approximate asymptotic form of the solution. (JFP)

2257 DIFFERENTIAL PROPERTIES OF FEYNMAN INTEGRALS. Barucchi, G. (Univ., Turin); Ponzano, G. Nuovo Cim., 23A: No. 4, 733-742(21 Oct 1974).

It is shown how the differential properties of one-loop generalized (with Speer λ-parameters) Feynman integrals free from second-type singularities lead to the complete characterization of the analytic properties of these functions. (auth)

2258 GENERALIZED PHASE SPACE FORMULATION OF THE HAMILTONIAN DYNAMICS. Razavy, M.; Kennedy, F. J. (Univ. of Alberta, Edmonton). Can. J. Phys.; 52: No. 16, 1532-1546(15 Aug 1974).

In an n dimensional phase space, the generator of the time translation can be written in terms of a Hamiltonian and a set of Poisson brackets for the phase space variables. When the velocity vector in this phase space is divergenceless, then the equations of motion reduce to those obtained by Nambu. The extension of the Hamiltonian dynamics to the phase space of arbitrary dimensions enables one to find a generalized Hamiltonian function for equations of motion involving time derivatives of any order (even or odd) of the coordinates. The problem of quantization of Nambu's generalized dynamics is studied, and it is shown that in certain cases, for a system moving under a set of constraints, it is possible to replace the Hamiltonian operator by an infinite number of generators of time translation functions. Some examples from classical dynamics and quantum mechanics are given to show the range of applicability of the generalized phase space formulation. (auth)

2259 QUANTUM PHYSICS AND THE PHILOSOPHICAL TRADITION. Petersen, A. Cambridge, MA; Massachusetts Institute of Technology Press (1968). 207p.

The topics discussed cover the relation between science and philosophy, the development of ontological philosophy, the classical and quantum history of atomism, and the relation of quantum physics with traditional philosophy. (JFP)

Quantum Field Theories

Refer also to abstracts 1601, 1698, 1699, 1774, 1802, 1888, and 2301.

2260 (DESY-74/37) ABELIAN GAUGE INVARIANCE OF NONABELIAN GAUGE THEORIES. Brandt, R. A.; Wing-Chiu, N. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Aug 1974. 35p. Dep. NTIS (US Sales Only) $4.75.

The ultraviolet asymptotic freedom of a large class of nonabelian gauge theories enable the renormalization constants to be computed exactly in perturbation theory. This exact knowledge is used in investigating renormalized field equations of such theories. They are shown to be invariant under an abelian gauge transformation on the renormalized vector field. Consequences of the abelian invariance are derived in the form of Ward-Takahashi identities for the renormalized proper vertices $\Gamma_R^{\cdots\mu\cdots}(\ldots, q, \ldots)$: $q_\mu \Gamma_R^{\cdots\mu\cdots}(\ldots, q, \ldots) = 0$. (auth)

2261 (DESY-74/38) INFRARED BEHAVIOR IN NONABELIAN GAUGE THEORIES. Brandt, R. A.; Wing-Chiu, N. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Aug 1974. 28p. Dep. NTIS (US Sales Only) $4.50.

The knowledge of the renormalization constants in ultraviolet free nonabelian gauge theories is exploited in exposing a new symmetry, R: $\vec{A}_\mu(x) \to \vec{A}_\mu(x) + \vec{r}_\mu$, under which the renormalized field equations of such theories are invariant. As a consequence, the low energy theorem for the renormalized proper vertices $\Gamma_R^{\cdots\mu\cdots}(\ldots, q, \ldots)$ as: $0 = \Gamma_R^{\cdots\mu\cdots}(\ldots, q = 0, \ldots)$. The relevance of the theorem to the existence of the S-matrix, confinement problem, etc. is discussed. (auth)

2262 (RRK-73-21) CANONICAL QUANTUM ELECTRODYNAMICS WITH INVARIANT ONE-PARAMETER GAUGE FAMILIES. Yokoyama, K. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Dec 1973. 23p. NTIS (US Sales Only).

Canonical quantum electrodynamics in general one-parameter covariant gauges is formulated by introducing two kinds of dipole ghost fields. One corresponds to the longitudinal photon field, while the other is called a gaugeon field. None of these dipole ghosts is included in physical states by supplementary conditions. There are two invariant gauge families in the sense that two arbitrary gauges belonging to the same family are connected with each other by a q-number gauge transformation in a manifestly covariant way. The shift of gauge through renormalization is naturally derived from the gauge-structure of the formalism. (auth)

2263 (RRK-74-1) GAUGE STRUCTURE OF CANONICAL QUANTUM ELECTRODYNAMICS. Yokoyama, K.; Kubo, R. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Jan 1974. 22p. NTIS (US Sales Only).

Possible gauge-structures associated with the q-number gauge transformation generated by a dipole gaugeon field are extensively studied in the framework of canonical quantum electrodynamics. The gauge-structures are classified into two types, which will be referred to as type I and type II, respectively. A typical gauge-structure in type I is the one presented previously. In type I all possible one-parameter covariant gauges are divided into two gauge families complementary to each other, each of which is invariant with respect to the gauge transformation, while in type II there does not occur such a division for gauges and a single gauge families covers the whole region for gauges. Circumstances of the gauge-shift through renormalization and structures of binary dipole systems consisting of the longitudinal photon and the gaugeon fields are discussed for each of these two types of gauge-structure. (auth)

2264 QUANTUM ELECTRODYNAMICS. Kaellen, G. New York; Springer-Verlag, New York, Inc. (1972). 247p. $10.80.

Translated from the German by C. K. Iddings and M. Mizushima.

The following topics are covered: general principles; the free electromagnetic field; the free Dirac field; the Dirac field and the electromagnetic field in interaction; elementary applications; radiation corrections in the lowest order, and general theory of renormalization. (LBS)

2265 CORRECTIONS TO THE ASYMPTOTIC BEHAVIOR OF CORRELATION FUNCTIONS WITHIN THE SCALING REGIME. Brezin, E.; De Dominicis, C.; Zinn-Justin, J. (CEN de Saclay, Gif-sur-Yvette, France). Lett. Nuovo Cim.; 10: No. 18, 849-851(31 Aug 1974).

It is pointed out that higher-order correction terms are related to the anomalous dimensions associated with higher composite operators. The effect of these operators on the expansion of the correlation function is examined. (LBS)

2266 ANOMALOUS DIMENSIONS AND THE MULTIPLICATIVE RENORMALIZATION GROUP. Forgacs, G. (Central Research Inst. for Physics, Budapest). Lett. Nuovo Cim.; 10: No. 18, 845-848(31 Aug 1974).

It is shown that the anomalous dimension of the φ^2-field in the φ^4-theory can be easily calculated by using the Gell-Mann and Low multiplicative renormalization group. (LBS)

2267 WARD-TAKAHASHI IDENTITIES ON QUANTUM FIELD THEORY WITH SPONTANEOUSLY BROKEN SYMMETRY. Nakanishi, N. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 51: No. 4, 1183-1192(Apr 1974).

For the theory with spontaneously broken phase symmetry, the Ward-Takahashi-type identities, which are qualitatively different from the corresponding ones in the unbroken theory, are proved in the framework of quantum field theory. On the other hand, for the spontaneously broken gauge theory, the Ward-Takahashi identities are shown to be the same as those in the unbroken theory, as far as the abelian gauge field is concerned. (auth)

2268 GAUGE FIELDS FOR SYMMETRY GROUP WITH SPINOR PARAMETERS. Volkov, D. V.; Soroka, V. A. (Physical-Technical Inst., Kharkov). Teor. Mat. Fiz.; 20: No. 3, 291-298 (Sep 1974). (In Russian).

Introducing of gauge fields for symmetry groups including anticommuting parameters is considered. The Higgs phenomenon for the Goldstone fields with spin $\frac{1}{2}$ is discussed. (auth)

2269 THE WILSON APPROACH TO THE RENORMALIZATION GROUP AND THE REGGEON CALCULUS. Jengo, R. (Trieste Univ. (Italy). Istituto di Fisica Teorica). Phys. Lett., B; 51: No. 2, 143-145(22 Jul 1974).

Using a technique by Wilson which deals with the bare Lagrangian the problem of the critical behavior of the interacting Pomeron is investigated. The author finds beside the strong coupling solution recently discussed, also the weak coupling solutions originally presented by Gribov and Migdal. (auth)

2270 HIGHER ORDER TERMS IN THE EPSILON EXPANSION OF THE POMERON PROPAGATOR. Baker, M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). Phys. Lett., B; 51: No. 2, 158-160(22 Jul 1974).

The indices η, ν and γ which characterize the high energy behavior of the elastic scattering amplitude in the presence of a nonvanishing triple Pomeron interaction are calculated to order ϵ^2 where $4-\epsilon$ is the dimension of the space of transverse momenta. (auth)

2271 SUPERGAUGE INVARIANCE AND THE GELL-MANN-LOW EIGENVALUE. Ferrara, S.; Zumino, B. (European Organization for Nuclear Research, Geneva (Switzerland)); Iliopoulos, J. (Paris-11 Univ., 91 – Orsay (France). Lab. de Physique Theorique et Hautes Energies). Nucl. Phys., B; 77: No. 3, 413-419(11 Aug 1974).

The connections among supergauge, scale and conformal invariance are elucidated on the example of a renormalizable field theory model. For the massless model, at the Gell-Mann-Low eigenvalue, a non-perturbative argument leads to the contradictory result that it can only describe a free field theory. A study of the Callan-Symanzik equations for the massive model clarifies the situation from the point of view of perturbation theory. It is argued that the eigenvalue equation has no non-trivial solution and that the effective coupling constant increases without bound with energy. (auth)

2272 PHI^3 THEORY IN SIX DIMENSIONS AND THE RENORMALIZATION GROUP. Macfarlane, A. J.; Woo, G. (Cambridge Univ. (UK). Dept. of Applied mathematics and Theoretical Physics). Nucl. Phys., B; 77: No. 1, 91-108(25 Jul 1974).

ϕ^3 field theory in six space-time dimensions is used as a testing ground for the renormalization group. The consistency of the new method devised by 't Hooft is verified at the two-loop level by exhibiting certain cancellations among single pole coefficients, and also relations among double and single pole coefficients. This calculation is contrasted in efficiency with one using the Gell-Mann-Low equation in dimensionally regularized form for which a solution is obtained at the one-loop level, without neglecting mass dependence. The theory shares with asymptotically free ones the virtue of an asymptotically vanishing effective coupling constant. Indeed, the next to leading term in the beta function is also of opposite sign to the coupling constant. (auth)

2273 PARAFERMI FIELDS OF ORDER 2 AND THE VARIATIONAL PRINCIPLE. Ohnuki, Y. (Alberta Univ., Edmonton (Canada). Theoretical Physics Inst.); Kamefuchi, S. (Tokyo Univ. of Education (Japan). Dept. of Physics). Nucl. Phys., B; 77: No. 1, 163-172(25 Jul 1974).

The theory proposed previously for a parafermi field of order

2 which satisfies only the locality condition of the weaker form is reformulated here on the basis of Schwinger's variational principle in a slightly generalized form. The generalization consists in assuming different forms of the Lagrangian function for the even and odd sectors of the state-vector space, the sectors being completely separated from each other by virtue of a superselection rule. As a consequence observables in general are shown to take different forms in the two sectors. The trilinear commutation relations specific to the field concerned are derived by assuming suitable properties for variations of the field operator. (auth)

2274 SUPERGAUGE MULTIPLETS AND SUPERFIELDS. Ferrara, S.; Zumino, B. (European Organization for Nuclear Research, Geneva (Switzerland)); Wess, J. (Karlsruhe Univ. (TH) (F. R. Germany)). Phys. Lett., B; 51: No. 3, 239-241(5 Aug 1974).

Superfields are defined as functions of the space-time variable χ and of anticommuting two-component spinors θ and $\bar{\theta}$. They have definite transformation properties under supergauge transformations. Their expansion in θ and $\bar{\theta}$ generates a finite number of ordinary fields forming a multiplet. A number of operations are defined which allow the construction of new superfields from given ones. The corresponding set of multiplets is complete, in the sense that the product of any two can be decomposed as a sum of multiplets belonging to the same set. (auth)

2275 AN ASYMPTOTICALLY FREE REGGEON FIELD THEORY. Brower, R. C.; Ellis, J. (California Univ., Santa Cruz (USA). Div. of Natural Sciences). Phys. Lett., B; 51: No. 3, 242-246(5 Aug 1974).

Renormalization group techniques are used to examine Reggeon field theories with derivative triple Pomeranchuk interactions in accord with the decoupling theorems. The simplest asymptotically free "weak coupling" solution has total cross sections which behave as $\sigma_{tot}^{AB}(s) \sim g_A g_B - c/\log s + \ldots$, and the triple Pomeranchuk vertex has a nonsense wrong signature zero asymptotically $\sim (t - t_1 - t_2)$. Another "strong coupling" solution reproduces the results of Migdal, Polyakov, Ter-Martirosyan, Abarbanel and Bronzan to lowest order in the ϵ-expansion. (auth)

2276 RENORMALIZATION CONSTANTS IN ASYMPTOTICALLY FREE FIELD THEORIES. Ng, W. C. (State Univ. of New York, Stony Brook (USA). Inst. for Theoretical Physics); Young, K. (Chinese Univ. of Hong Kong, Shatin). Phys. Lett., B; 51: No. 3, 291-294(5 Aug 1974).

Renormalization constants Z_1 for asymptotically free field theories can be computed via renormalization group techniques from perturbation theory. We show that there exists a subclass of these theories in which, by virtue of a new eigenvalue condition on the gauge parameter, the Z_1 are asymptotically gauge independent, and hence can vanish in all gauges. (auth)

2277 SELF-CONSISTENT POMERANCHUK SINGULARITIES IN REGGEON FIELD THEORIES. Abarbanel, H. D. I. (National Accelerator Lab., Batavia, Ill. (USA)). Phys. Lett., B; 51: No. 3, 295-298(5 Aug 1974).

A self-consistency or bootstrap principle is suggested to determine the structure of the Pomeranchuk singularity in the neighborhood of $J = 1$ and $t = 0$. The ingredients in this are a Reggeon field theory which is required to be renormalizable and infrared free in the sense of the renormalization group. This guarantees that the input singularity reproduces itself near $J = 1$, $t = 0$ with small computable corrections. Several examples of physical significance are discussed. (auth)

2278 A COMPENSATING FUNCTIONAL METHOD IN THE MASSIVE YANG-MILLS THEORY. Batalin, I. A. (P. N. Lebedev Physical Institute, Academy of Sciences, USSR). Nucl. Phys., B; 76: No. 2, 347-364(11 Jul 1974).

In the massive and massless Yang-Mills theories the generating functional (the S-matrix) independence of the gauge parameter is provided on the mass shell without introducing an extra degree of freedom (gauge group integration). (auth)

2279 BROKEN SUPERGAUGE SYMMETRY AND RENORMALIZATION. Iliopoulos, J. (Paris-11 Univ., 91 – Orsay (France). Div. De Physique Theorique); Zumino, B. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 76: No. 2, 310-332(11 Jul 1974).

A field theory model invariant under supergauge transformations is shown to be renormalizable to all orders in perturbation theory. Renormalization is shown to be consistent with supergauge invariance. It is further shown that only one renormalization constant is needed, a common wave function renormalization for all fields. A symmetry breaking term is introduced which breaks the symmetry explicitly but so smoothly that the renormalization procedure of the symmetric case can still be applied. Relations among masses and coupling constants emerge. Among other topics discussed, the possibility that the supergauge symmetry is spontaneously broken and that a Goldstone spinor appears is examined. (auth)

2280 NOTE ON COVARIANT DERIVATIVES IN THE QUANTUM FIELD THEORY. Okabayashi, T. (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 51: No. 2, 592-599(Feb 1974).

Physical conditions, which must be introduced in translating covariant derivatives in classical field theory into quantum-theoretical ones, are discussed. It is also shown that the present approach gives a simple foundation to use the Lagrangian or energy-momentum tensor density operator of the Podolsky form for irreducible systems of nonlinear fields. (auth)

2281 STUDY OF EXTERNAL BOUNDARY PROBLEMS OF THE DIRICHLET AND NEUMANN TYPE FOR THE BASIC EQUATION OF AXIALLY-SYMMETRIC FIELD THEORY BY A POTENTIAL METHOD. Radzhabov, N.; Sattarov, A. S. (Tadzhik State Univ., USSR). Dokl. Akad. Nauk Tadzh. SSR; 17: No. 5, 7-11(1974). (In Russian).

Let D^+ designate a region lying in the semiplane $y > 0$ bounded above by the curve G and a section $l = (a,b)$ of a real axis. Let D^- be a region external with respect to D^+ and lying in the semiplane $y > 0$. The purpose of this study is to find the potentials of the simple and double layers for a differential equation of the potential on the plane, and also to obtain integral equations for internal and external boundary problems of the Dirichlet and Neumann type. The Fredholmness of these integral equations is proved. The singularity of the solution of external boundary problems and of the corresponding integral equations is proved. (SJR)

2282 PARAFERMI FIELDS OF EVEN ORDER. Ohnuki, Y. (Univ. of Alberta, Edmonton); Kamefuchi, S. Progr. Theor. Phys. (Kyoto); 51: No. 4, 1206-1219(Apr 1974).

The theory of a parafermi field developed previously for the case of order $p = 2$ is generalized to the case of even order $p = 2k$, where the field is assumed to satisfy only the locality condition of the weaker form. As in the case $p = 2$, observables are required in general to take different forms in the even and odd sectors of the state-vector space. It is concluded that the field possesses the cluster property and further that it has a relation of weak and local equivalence with a fermi field with a hidden variable that takes on p different values. In contrast with the case $p = 2$, the field of order $p = 2k$ with $k \geq 2$ describes only one species of particles. (auth)

2283 ABSENCE OF BOUND STATES IN THE $\lambda\varphi_2^4$ QUANTUM FIELD MODEL WITHOUT SYMMETRY BREAKING. Feldman, J. (Harvard Univ., Cambridge, MA). Can. J. Phys.; 52: No. 16, 1583-1587(15 Aug 1974).

A $\lambda\varphi_2^4$ model with a unique vacuum, invariant under the symmetry $\varphi \rightarrow -\varphi$ is studied, and it is assumed that certain connected 4n-point Euclidean Green's functions are negative. Then the mass operator, $M = (H^2 - P^2)^{1/2}$, restricted to the space of states that are even under $\varphi \rightarrow -\varphi$, has no spectrum in the interval $(0,2m)$. In particular, two particle bound states do not occur in the single phase region (i.e. $\lambda < \lambda_{critical}$). (auth)

2284 PARTICLE BEHAVIOR IN AESTHETIC FIELD THEORY. Muraskin, M.; Ring, B. (Univ. of North Dakota, Grand Forks). Found. Phys.; 4: No. 3, 395-405(Sep 1974).

The structure of a particle system obtained in "aesthetic" field theory is discussed, and the evolution of this system in time is studied. The particle system is found to have more structure than particles found by others investigating particlelike behavior in nonlinear field theories. The particle system has a maximum center in proximity to a minimum center. Thus, one can interpret the system as being constructed of two bodies. It is found that the maximum center and the minimum center move in straight lines to computer accuracy. Thus, any nontrivial force laws were not found. This suggests that the situation with respect to basic principles be kept fluid. So far as one knows this is the first investigation to study the trajectories of a two-body system which arises as a consequence of nonlinear field equations. (auth)

2285 SIMPLIFIED FOUR-FERMION "RENORMALIZABLE" MODEL. Caramico D'Auria, A. (Inst. of Mathematics, Naples); Esposito, U. Lett. Nuovo Cim.; 11: No. 1, 47-50(7 Sep 1974).

The possibility of extending the class of the renormalizable theories is considered. A model with a four-fermion interaction without antiparticles is studied. The model is described by an interaction Hamiltonian. (JFP)

2286 FORM FACTORS IN RENORMALIZED EIKONAL PERTURBATION THEORY. Oleari, C.; Orzalesi, C. A.; Tau, M.

(Univ., Parma, Italy). Lett. Nuovo Cim.; 11: No. 1, 69-74(7 Sep 1974).

Expressions for on- and off-shell form factors are derived in lowest-order eikonal perturbation theory. The renormalization of such Green functions and some of their asymptotic properties for large momenta are discussed. (JFP)

2287 EFFECTIVE POTENTIALS VIA THE BACKGROUND FIELD METHOD AND DIMENSIONAL REGULARIZATION. Brown, M. R.; Duff, M. J. (Oxford Univ.). Lett. Nuovo Cim.; 11: No. 1, 80-82(7 Sep 1974).

It is pointed out that the Dyson–Schwinger equations follow almost immediately if one adopts the background field method as advocated by De Witt and that the resulting divergences may be rapidly and elegantly removed by dimensional regularization. The methods outlined are well suited to the further problem of determining the effective Lagrangian. (JFP)

2288 EXACT ASYMPTOTIC BEHAVIOR OF $g\phi^4$ THEORY FROM STATIC ULTRA-LOCAL APPROXIMATION. Caianiello, E. R.; Scarpta, G. (Univ., Salerno, Italy). Lett. Nuovo Cim.; 11: No. 4, 283-286(28 Sep 1974).

The observation is considered that the model of the static ultra-local approximation of the $g\phi^4$ quantum field theory yields also the exact limit of the physical theory when g and m^2 go to infinity in such a way that the rate g/m^4 remains finite. (JFP)

2289 SYMMETRY OF THE HOMOGENEOUS SCHWINGER–DYSON EQUATIONS. Konopelchenko, B. G. (Inst. of Nuclear Physics, Novosibirsk, USSR). Lett. Nuovo Cim.; 11: No. 4, 271-274(28 Sep 1974).

A symmetry of the renormalized equations for Green's functions is investigated. It is shown that the homogeneous Schwinger–Dyson equations for arbitrary interactions are invariant under arbitrary Lie groups. Therefore, these equations permit the solutions with arbitrary symmetry. Hence, any solution of the homogeneous Schwinger–Dyson equations is continuously degenerate. For definiteness a theory of one interacting scalar field is considered. (JFP)

2290 EQUATIONS FOR THE GREEN FUNCTIONS OBTAINED FROM THE VARIATIONAL PRINCIPLE. Kazanskii, A. K. (Leningrad State Univ.). Teor. Mat. Fiz.; 21: No. 1, 3-12(Oct 1974). (In Russian).

Starting from the stationarity conditions for the Legendre transformations equations are deduced for the renormalized as well as the nonrenormalized Green functions in the φ^3 and φ^4 theories. (auth)

2291 TWISTED EIKONAL GRAPHS AND STRUCTURE OF THE QUASIPOTENTIAL. Kuleshov, S. P.; Matveev, V. A.; Sissakyan, A. N.; Smondyrev, M. A.; Tavkhelidze, A. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 21: No. 1, 30-36(Oct 1974). (In Russian).

On the basis of the straight-line paths method the asymptotics of the twisted eikonal graphs is investigated. These graphs violate the eikonal representation with the effective Yukawa potential for the sum of the ladder graphs already in the lower orders of perturbation theory. The results obtained are used for reconstructing the asymptotical quasi-potential. (auth)

2292 EIKONAL APPROXIMATION AND THE LARGE-MASS EXPANSION IN FIELD THEORY. Car, R.; Cicuta, G. M. (Univ., Milan). Lett. Nuovo Cim.; 11: No. 6, 358-362(12 Oct 1974).

An exact expansion in the large mass limit for a relativistic particle in an arbitrary external field is derived. The asymptotic expansion obtained is defined for the amputated propagator on the mass shell, and this is sufficient to derive an approximation for the elastic two-body scattering amplitude. The method of investigation is described, and the preliminary results are quoted. This investigation supports a conclusion for the validity of the eikonal approximation in the scalar elastic two-body scattering amplitude. (JFP)

2293 RENORMALIZATION OF WILSON OPERATORS IN GAUGE THEORIES. Dixon, J. A.; Taylor, J. C. (Oxford Univ. (UK). Dept. of Theoretical Physics). Nucl. Phys., B; 78: No. 3, 552-560(4 Sep 1974).

The operators in a Wilson expansion are not in general multiplicatively renormalized in non-Abelian gauge theories. This is because of the renormalization of the gauge transformations themselves. Renormalized fields may be defined, which have the old gauge transformations. Alternatively, a special choice of gauge may be made, in which the gauge transformations are unchanged on renormalization. In any case, one gauge invariant factor appears in the renormalization of the Wilson operators. (auth)

2294 RENORMALIZATION IN NON-ABELIAN GAUGE THEORIES. Kallosh, R. (AN SSSR, Moscow. Fizicheskij Inst.). Nucl. Phys., B; 78: No. 2, 293-312(25 Aug 1974).

The renormalization is performed in a manifestly covariant approach. The simplest form of the Ward identities $z_1 = z_2 = \ldots = z_n = \ldots$ is fulfilled automatically in every gauge. In the Yang-Mills theory the counter-terms are gauge-invariant and depend on the charge renormalization constant only. In pure gravitation the analysis of all divergences is reduced in the present approach to some special classification of the kth order scalar densities in a Riemannian space. (auth)

2295 SUPER-SYMMETRY AND NON-ABELIAN GAUGES. Salam, A.; Strathdee, J. (International Centre for Theoretical Physics, Trieste (Italy)). Phys. Lett., B; 51: No. 4, 353-355 (19 Aug 1974).

It is shown that the conventional Yang-Mills Lagrangian with the Yang-Mills field interacting with Majorana fermions belonging to the adjoint representation of an internal symmetry group like SU(n) is super-gauge invariant. (auth)

2296 A GAUGE THEORY OF WEAK AND ELECTROMAGNETIC INTERACTIONS WITH SPONTANEOUS PARITY BREAKING. Fayet, P. (Paris-11 Univ., 91–Orsay (France). Lab. de Physique Nucleare et Hautes Energies). Nucl. Phys., B; 78: No. 1, 14-28(18 Aug 1974).

A unified gauge theory of weak and electromagnetic interaction is presented in which parity is spontaneously broken together with gauge invariance, by the Higgs mechanism. The gauge group is $SU(2) \times U(1)$, and a heavy neutrino is associated with every charged lepton. After the breaking of the original parity-conserving theory, both a purely vector electromagnetic current and the usual V-A charged currents are obtained. Z is coupled to a vector electron current, and the model predicts equal $\nu_\mu e$ and $\bar{\nu}_\mu e$ cross sections. Extension to hadrons is made by introducing three charmed quarks p',n' and λ' of the same charges as p,n and λ. All the experimental results ($\nu_\mu e$, $\bar{\nu}_\mu e$, $\bar{\nu}_\mu e$, ν_μ, and $\bar{\nu}_\mu$ hadron scatterings) are compatible with a value of $\sin^2 \theta_w$ of order 0.4. (auth)

2297 SUPERGAUGE INVARIANT EXTENSION OF QUANTUM ELECTRODYNAMICS. Wess, J. (Karlsruhe Univ. (TH) (F. R. Germany)); Zumino, B. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 78: No. 1, 1-13 (18 Aug 1974).

A minimal supergauge invariant extension of quantum electrodynamics is described. It contains a spinor, a scalar and a psuedoscalar field, all charged, plus the photon field and a massless Majorana spinor. A Lagrangian invariant under gauge and supergauge transformations is constructed and shown to be renormalizable in the one-loop approximation. (auth)

2298 SUPERGAUGE INVARIANT YANG-MILLS THEORIES. Ferrara, S.; Zumino, B. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 79: No. 3, 413-421(25 Sep 1974).

Lagrangian theories are constructed which are simultaneously invariant under supergauge transformations and under Yang-Mills transformations. The simplest of these turns out to be just the usual theory describing the interaction of a Yang-Mills field with a Majorana spinor belonging to the regular representation of the internal symmetry group. This theory is asymptotically free. Other examples, involving in addition to spinors also scalar and pseudoscalar fields, are described. They also are asymptotically free, provided the number of scalar supermultiplets is not too high and supergauge invariance, as expected, is preserved by renormalization. (auth)

2299 POINT TRANSFORMATIONS AND RENORMALIZATION IN THE UNITARY GAUGE. Mainland, G. B.; O'Raifeartaigh, L.; Sherry, T. N. (Dublin Inst. for Advanced Studies (Ireland)). Nucl. Phys., B; 79: No. 3, 503-525(25 Sep 1974).

It is shown by means of a model that the renormalization and unitary gauges can be connected by a point transformation, and this fact is used to construct a formal proof of renormalization in the unitary gauge. The formal proof is then verified by demonstrating that for a fourth-order on-shell scattering process the S-matrix calculated directly in the unitary gauge is exactly equal to that calculated in the renormalization gauge. The calculation is refined to the point where it becomes purely graphical and this allows one to see by inspection how the cancellation of divergences occurs in the unitary gauge. The model considered here is Abelian, but it will be generalized to the non-Abelian case subsequently. (auth)

2300 NON-ABELIAN GAUGE THEORIES FOR HADRONS AND RADIATIVE CORRECTIONS. Kainz, W.; Kummer, W.;

Schweda, M. (Technische Hochschule, Vienna (Austria). Inst. fuer Theoretische Physik). Nucl. Phys., B.; 79: No. 3, 484-502 (25 Sep 1974).

The anomalous dimensions of the twist-4 operators which determine the asymptotic behavior of radiative corrections are computed for non-Abelian gauge theories. In Lorentz gauges, the ghost problem appears to be highly non-trivial, and there is no simple set of operators which yield consistent results. However in the ghost-free axial gauges, a gauge invariant result for the expansion of two gauge invariant currents is found. (auth)

Gravitation and General Relativity

2301 (AD-779789) QUANTUM FIELDS AND GRAVITATION. Final Report, 1 October 1969-31 December 1973. Deser, S. (Brandeis Univ., Waltham, Mass. (USA). Dept. of Physics). 1974. 11p. (AFOSR-TR-74-0816). NTIS $3.00.

A number of problems on the interface between gravitation and quantum theory were investigated. These include: restrictions on coupling of matter sources to gravitation, alternatives to Einstein theory and experimental constraints on the theory; stability of solutions of Einstein equations near vacuum, and in closed spaces; and, the finite range problem in gravitation and the discontinuities between finite and infinite range predictions. (auth)

2302 NUMERICAL EXPERIMENTS ON EXPANDING GRAVITATIONAL SYSTEMS. Janin, G.; Haggerty, M. J. (Univ. of Texas, Austin). J. Comput. Phys.; 16: No. 1, 76-92(1 Sep 1974).

An experimental study of expanding gravitational systems of N bodies is performed by means of computer experiments. A description of the numerical techniques, integration scheme, special handling of close encounters, is given. The effect of the rest of the universe on the system is simulated by adding a smooth time dependent gravitational field. The results are compared with the evolution of similar systems with more discrete particles placed outside. During the computer experiments, a reduction of the number of bodies is sometimes made by reducing small subclusters to single particles at their centers of mass. For $25 \leq N \leq 200$, the results are shown to be sensitive to nearby external physical sources. Some very accurate, reversible and reproducible runs were made in order to show that the computations represent purely gravitational interactions, without uncontrolled and unphysical perturbations. (auth)

2303 REVISION OF RESTRICTED RELATIVITY IN THE DIRECTION OF GENERAL RELATIVITY. Peretti, G. Rend. Ist. Lombardo Sci. Lett., A; 107: No. 1, 95-101(1973). (In Italian).

Development of a slight revision of the quantity ds squared in restricted relativity (and thus of the Newtonian law of point mechanics), as a result of which the velocity of light is influenced by the presence of a gravitational field. In this new hypothesis the geometric properties relative to the universe line S are interpreted in a chronotope which, by analogy with what occurs in general relativity, is no longer pseudo-Euclidean. (IAA)

2304 KERR-SCHILD METRIC CANNOT HAVE AN ACCELERATING SOURCE. Hogan, P. A. (Texas Univ., Austin (USA)). Phys. Lett., A; 48: No. 4, 265(1 Jul 1974).

A simple proof is given that if the source of a vacuum electromagnetic or purely gravitational Kerr-Schild metric is a worldline in the background Minkowski space-time then the 4-acceleration of the world-line must vanish. (auth)

2305 PHYSICAL STRUCTURE OF PERICENTER DISPLACEMENT IN THE GRAVITATIONAL FIELD OF A ROTATING MASS. Ivanitskaya, O. S.; Mityanok, V. V. (Inst. of Physics, Minsk). Vestsi Akad. Nauk BSSR, Ser. Fiz.-Mat. Nauk; No. 4, 57-61 (1974). (In Russian).

A study was made on the physical structure of GRT (general relativity theory) corrections, which depend on the rotating momentum of a gravitating mass, on additional displacement of the latitude of a test body moving in a Kerr field. In the case of a circular orbit it was established that the GRT correction 4a $m^{0.5}/p^{1.5}$, which was already found by Lenze and Thirring, is related with introducing into GRT of a local requirement with respect to physical simultaneity, and therefore is not relativistic in the sense of a locally correct SRT (special relativity theory). It is proposed that this correction is a consequence of an Einsteinian generalization of the concept of a gravitational field source. (SJR)

2306 GRAVITATIONAL BACKGROUND PLACED IN 5-DIMENSIONAL FIELD EQUATIONS. Bedritskii, A. I. (State Teachers Inst., Minsk). Vestsi Akad. Nauk BSSR, Ser. Fiz.-Mat. Nauk; No. 4, 62-71(1974). (In Russian).

It is shown in a definite approximation that 5-dimensional field equations, which are invariant with respect to an expanded 5-dimensional Lorentz group, include a global gravitational background. The 5-dimensional Lorentz group can be reduced to a 4-dimensional group by setting the fifth variable equal to a constant. In solving the problem, use is made of a decomposition of the 4-dimensional space curve into a family of hyperboloids, which is designated in plane, 5-dimensional space by a space-time interval s as a parameter. It is pointed out that concrete physical problems, solved by the author on the basis of the 5-dimensional equations, confirmed the conclusion on the presence of a gravitational background. (SJR)

2307 INTERIOR METRIC OF A CHARGED-DUST CYLINDER IN GENERAL RELATIVITY. Krori, K. D.; Barua, J. (Cotton Coll., Gauhati, India). Indian J. Pure Appl. Phys.; 12: No. 6, 430-433(Jun 1974).

The interior metric of a charged-dust cylinder was discussed in some special cases on the basis of general relativity. (auth)

2308 MASSIVE SPHERES WITH CONSTANT-DENSITY CORES AND TWO VARIABLE-DENSITY OUTER SHELLS IN GENERAL RELATIVITY. Krori, K. D.; Borgohain, P. (Cotton Coll., Gauhati, India). Indian J. Pure Appl. Phys.; 12: No. 6, 423-429(Jun 1974).

Tolman's solutions of Einstein's field equations for fluid spheres are applied to describe three classes of spheres of three-density distributions. Each of them has a constant-density core and two variable-density outer shells described by two of the above solutions. Conditions under which these spheres become physical are discussed. The astrophysical implications of these deductions are also pointed out. (auth)

2309 CREATION-FIELD THEORY FROM DIMENSIONAL ANALYSIS. Lord, E. A. (Indian Inst. of Science, Bangalore, India). Pramana; 3: No. 1, 35-43(Jul 1974).

A Lagrangian is obtained which is invariant under space-time dependent changes in the units of mass, length and time. It contains two scalar fields, one of which is effectively the Brans-Dicke scalar (varying gravitational constant), while the other can be interpreted as a creation-field. (auth)

2310 GENERALIZED KERR-SCHILD METRIC. Vaidya, P. C.; Bhatt, P. V. (Gujarat Univ., Ahmedabad, India). Pramana; 3: No. 1, 28-34(Jul 1974).

A metric $g_{ik} = \eta_{ik} + H\xi_i\xi_k + 2J\xi_{(iPk)}$ is investigated. When $J = 0$ this reduces to the well known Kerr metric. Conditions on the vector p_i are obtained under which a geodetic, shear-free null congruence ξ_i in the Minkowskian space-time (with metric η_{ik}) will continue to remain geodetic and shear-free in the Riemannian space-time of g_{ik}. A general solution of Einstein's equation $R_{ik} = \sigma\xi_i\xi_k$ is obtained when $p_i\xi^i = 0$ and ξ_i is twist-free. (auth)

2311 POINCARÉ COVARIANCE AND QUANTIZATION OF ZERO-MASS FIELDS. II. The Weak Gravitational Field. Bertrand, J. (Univ., Paris). Nuovo Cim., 23A: No. 4, 703-715(21 Oct 1974).

Following the work done previously on the quantization of a potential vector A^μ, the consequences of general requirements such as Poincaré covariance and basic quantum mechanics (i.e., existence of a Hilbert space of one-particle states supporting a unitary representation of Poincaré group P) on the quantization of a symmetric tensor field $h^{\mu\nu}$. While in the case of the electromagnetic potential one had a 2-parameter family of metrics all equivalent to Gupta's and corresponding to a transverse photon, a wide variety of descriptions for the graviton. First one must choose between a graviton possessing helicities 0, ±2 and a transverse one. Then, one has two different ways of getting rid of the helicities 0: one may suppress them covariantly or "gauge them away." Previously one had obtained directly a quantification of Maxwell's equations while, one must postulate Einstein linearized equations as an additional requirement which only mildly narrows the above choice. (auth)

2312 SECOND-ORDER DIVERGENCE CONDITIONS IN GENERAL RELATIVITY. Debney, G. (Virginia Polytechnic Inst. and State Univ., Blacksburg); Zund, J. D. Lett. Nuovo Cim.; 11: No. 1, 18-20(7 Sep 1974).

Two new derivations of the divergence conditions in general relativity are presented, and their physical content determined. A previous result with present simpler derivations is presented. Then the physical content of the second-order divergence conditions in general relativity is considered. (JFP)

2313 NONSYMMETRIC PROBLEMS IN GENERAL RELATIVITY. Bera, K. (Presidency Coll., Calcutta (India)); Datta, B. K. (Department of Mathematics, Surendra Nath College, Calcutta 9, India). Physica; 72: No. 3, 616-623(1974).

An attempt is made to study the nonsymmetric motion of a perfect fluid in the framework of general relativity. It is assumed

that all the thermodynamic processes are adiabatic and that only mechanical energy may be released in the process. By dealing with the Cauchy problem for a perfect fluid and introducing comoving coordinates, a new solution is obtained. (auth)

2314 STRONG GRAVITY THEORY OF HADRONS. Friedl, J. Albany; State Univ. of New York (1974). 260p. University Microfilms Order No. 74-23,197.

Thesis (Ph. D.).

An attempt is made, with the notion of strong gravity, to construct a geometrical model for hadrons. Strong gravity is characterized by its strong coupling with a hadronic matter (stronger by a factor of 10^{39} than the Newtonian coupling) and its geometrical nature (the Einsteinian attribute with or without modification). (Diss. Abstr. Int., B)

REACTOR TECHNOLOGY AND REGULATION

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 471, 2421, 2502, 2522, 2523, 2566, 2572, and 2574–2576.

2315 (AD-777413) SELECTED TRANSLATIONS. Translated from At. Energ. (USSR); No. 1, 39-42(1973). 13p. (NISC-TRANS-3485). NTIS $4.00.

Topics treated are leak detection in primary coolant circuits of water cooled, water moderated power reactors and testing of fuel elements in channel-loops with natural coolant circulation. (GRA)

2316 (INIS-mf-1312) EXPERIMENTAL INVESTIGATION OF CRITICAL HEAT FLUX IN VERTICAL TUBES AND ANALYSIS OF THE DATA. Madhyastha, K. P.; Ramamurthy, H.; Mehta, S. K. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 10p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

Experimental critical heat flux measurements obtained in a 100 kW boiling water loop in the Reactor Engineering Division of the Bhabha Atomic Research Centre are presented. The experiments were done on uniformly heated tubes in the ranges of inner diameters from 0.625 cm to 0.95 cm and lengths from 55 cms to 120 cms. The other parameters varied were (i) pressure, 42 Kg/cm^{2}g, (ii) inlet sub-cooling 5°C to 30°C and (iii) mass flux 120 gm/cm^2 sec to 500 gm/cm^2 sec. The experimental results have been compared with the published data and correlations. It has been observed that for tubes of L/D ratio beyond 140, disruption of liquid film seems to be the prominent factor in causing dryout while for tubes of L/D ratio below 100, evaporation of liquid film could be the prime factor. (auth)

2317 (TID-26628) TECHNICAL REPORT ON THE GENERAL ELECTRIC COMPANY 8 × 8 FUEL ASSEMBLY. (USAEC Regulatory Staff, Washington, D. C.). 5 Feb 1974. 35p. Dep. NTIS $4.75.

The results of the Regulatory Staff's generic review of the GE 8 × 8 fuel assemblies as used both in partial and full core reloads are presented. The review considered the effects that the changes in the fuel design have on normal operation, abnormal operational transients, and accidents. The review considered only generic aspects of the fuel design such as the adequacy of design methods, the comparative performance of the old and new fuel designs, and the applicability of accident analysis methods. (DG)

2318 (WASH-1208(9-74)) STATUS OF CENTRAL STATION NUCLEAR POWER REACTORS SIGNIFICANT MILESTONES. (USAEC Division of Reactor Research and Development, Washington, D. C.). 1 Sep 1974. 13p. Dep. NTIS $4.00.

2319 TREATMENT FOR BWR FUEL. Nishijima, T. (Japan Nuclear Fuel Co. Ltd., Yokosuka). Karyoku Genshiryoku Hatsuden; 24: No. 5, 534-537(May 1973). (In Japanese).

The fuel for BWRs differs from that for PWRs in the use of large diameter fuel rods, Zircaloy-2 for cladding, burnable poison, and channel box. The construction and production procedure of fuel assemblies, quality control, safety control, and problems for the future are described. The fuel assembly consists of a Zircaloy-4 square channel box, fuel rods, supporting plates, and so on. The procedure of its production starts with UO_2 pellets, which are then placed in Zircaloy cladding tubes, and the final one is fabrication into a fuel assembly. In quality control, there are the problems of burnable poison and fuel enrichment. Safety control of operation includes limit of criticality and weight control partly due to the high cost of fuel material. (JA)

2320 PROPOSED SALE OF La CROSSE BOILING WATER REACTOR TO DAIRYLAND POWER COOPERATIVE. Hearing Before the Joint Committee on Atomic Energy, Congress of the United States, Ninety-Third Congress, First Session, August 3, 1973. Washington, DC; Joint Committee on Atomic Energy (1974). 38p. GPO $0.40.

2321 LEAKTIGHTNESS MONITORING OF THE PRIMARY LOOP IN STEAM GENERATORS AT NUCLEAR POWER STATIONS USING WATER-MODERATED WATER-COOLED POWER REACTOR. Fedchenko, T. K.; Il'khman, A. A. Sov. At. Energy (Engl. Transl.); 34: No. 1, 49-51(Jan 1973).

Translated from At. Energ. (USSR); 34: No. 1, 39-40(Jan 1973). Monitoring of pressure-tightness by measuring the concentration of radioactive noble gases in the main steam line upstream of the turbine, and at blowdown points from the main ejectors of the turbines is considered. A conventional ejector is employed in order to bleed steam upstream of the turbine and in order to prepare specimens for monitoring. Calculations of the effectiveness of these monitoring techniques, based on the standard procedure, demonstrated the feasibility of carrying out the monitoring operation at the principal ejector stations, which is a technique roughly 400 times more sensitive than monitoring in the steam line upstream of the turbine. (auth)

2322 RADIOACTIVITY OF DEPOSITS IN A LOOP OF THE VK-50 REACTOR POWER STATION MEASURED WITHOUT SAMPLING. Kizin, V. D.; Polyakov, V. I.; Chechetkin, Yu. V. Sov. J. At. Energy (Engl. Transl.); 36: No. 2, 169-170(Feb 1974).

Translated from At. Energ. (USSR); 36: No. 2, 138(Feb 1974).

Scintillation γ-ray spectrometers were used for measurements of specific radioactivity in deposits on piping throughout the loop. The shielded detectors were placed against the piping or at a distance of 5 meters, and the pulse height analyzer was positioned at a distance of 70 meters from the detector. The absolute radioactivity per unit piping or equipment surface area was determined on the basis of approximate formulas. Comparison of investigative techniques was carried out on the piping of the drainage system serving the high-pressure separator. Coupons were cut from piping and sample smears were taken for the comparison, following sampling-free analysis of the activity of the deposits on the piping. Results of radioactivity measurements taken on the coupons were found to be in close agreement with the sampling-free measurements at the same points (the greatest discrepancy found was 23%). At the same time, results obtained from analysis of smears taken from the piping were lower. The smear ratio in these experiments ranged from 0.5 to 0.96. The specific activity of the deposits varied 26-fold (isotope ^{65}Zn) over a small section of piping extending about one meter in length, or 16-fold in the case of isotopes ^{60}Co and ^{59}Fe. Consequently, the results can turn out either too high or too low in analysis based on the standard procedure of measurement based on sample smears taken at the same point when the results are extended to a larger stretch of piping. The amount of specific activity of the isotopes in surface deposits on different portions of the loop differed anywhere from 10^2-fold to 10^4-fold. The radioactivity of the isotope ^{65}Zn was decisive over all portions of the loop. The specific activity of this isotope in the deposits on steam lines upstream of the high-pressure and low-pressure separators, the turbine, and the feedwater pump, were respectively: $1.8 \cdot 10^{-2}$, $2.3 \cdot 10^{-3}$, $1.4 \cdot 10^{-4}$, $0.6 \cdot 10^{-3}$ Ci/m^2. The radioactivity of ^{59}Fe, ^{60}Co, and ^{54}Mn in the deposits was anywhere from $1/50$ to $1/3$ the level of ^{65}Zn radioactivity, while the radioactivity of isotopes originating in fission fragments was 10^2 to 10^3 times smaller. (DG)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 2315, 2318, 2321, 2417, 2421, 2429, 2501–2504, 2513–2515, 2520, 2522, 2523, 2560, and 2573.

2323 (AED-CONF-73-223-004) CONSTRUCTION OF HEAVY REACTOR PRESSURE VESSELS FOR NUCLEAR POWER PLANTS. Effenberger, G. 1973. 3p. (In German). (CONF-730698-3).

From European meeting on chemical engineering and ACHEMA congress; Frankfurt am Main, F. R. Germany (20 Jun 1973).

The construction of the reactor pressure vessel with an overall weight of 540 tons for the Biblis reactor, Block A, is described. Some problems associated with the construction material and semi-finished material, with the mounting and welding of the vessel, as well as with quality assurance and acceptance criteria and tests together with calculations and hydrostatic tests and safety assessments are discussed in detail. (GE)

2324 (BASF-TLK-01) IMPORTANCE OF A NUCLEAR POWER PLANT FOR THE POWER SUPPLY OF THE BASF. Guenther. (See CODE-0743400 Badische Anilin- und Soda-Fabrik A. G. (BASF), Ludwigshafen am Rhein (F. R. Germany)). Oct 1973. 8p. (In German).

A comparison of the cost of conventional power plants with that of nuclear power plants shows that the latter are of greater advantage with regard to utilization in an industrial generating plant due to their high utilization factor. The capacity of the pressurized water reactor that has been chosen for the BASF power plant will be about that of the nuclear power plant Stade. It will be used to generate process steam (for the most part) and electricity. After

a description of the basic design of the plant, it is shown that failures of an industrial nuclear power plant due to malfunctions can be kept under control. (GE)

2325 (KFK-2029) DETERMINATION OF THE TURBULENT VELOCITY AND TEMPERATURE FIELD IN ROD BUNDLES USING GENERAL CURVILINEAR ORTHOGONAL CO-ORDINATES. Meyder, R. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Reaktorentwicklung). Sep 1974. 76p. (In German). Dep. NTIS (US Sales Only) $7.00.

The momentum and heat transfer equations for the central coolant channel of a reactor subassembly are solved for the first time in general curvilinear orthogonal co-ordinates. The coordinates were specially determined for the subchannel. The method is explained using the example of laminar flow. For turbulent flow, the eddy-diffusivities are determined by the "mixing-length" hypothesis of Prandtl. A new method is proposed to determine anisotropic eddy-diffusivities. The eddy-diffusivities of heat are calculated from the eddy-diffusivities of momentum using the relations obtained by various authors and the results are compared in the case of sodium. To show the capability of the developed computer-codes the three dimensional temperature field is calculated in the central subchannel of a fuel element cooled by sodium, helium and pressurized water. The agreement between calculated results and experiments is very satisfactory down to a P/D ratio of 1.15. 48 references. (auth)

2326 (MRR-135) PERIODIC PRESSURE FLUCTUATIONS IN PWR AND THEIR IMPORTANCE IN THE VIBRATIVE BEHAVIOUR OF REACTOR COMPONENTS. Bauernfeind, V. (Technische Univ. Muenchen, Garching (F. R. Germany). Lab. fuer Reaktorregelung und Anlagensicherung). Feb 1974. 100p. Dep. NTIS (US Sales Only) $8.00.

The spectral composition of pressure fluctuations measured at the STADE plant is discussed. The role of these pressure fluctuations as either exciting forces of motion or as the response to vibration of certain components is shown. It is demonstrated that the relative position of periodic lines and stochastic spectra parts to each other is of great importance with regard to the motion amplitudes of components. A vibration monitoring system based on dynamic pressure measurements is described. The conditions for the realization and the possibilities of the use of such a system are mentioned. The role of pressure fluctuations in simplification of preoperational tests and in additional design specifications is discussed. The measurement and interpretation of the fluctuating part of the system pressure can be seen as a method for recording, understanding, and supervising the vibrative behavior of the pressure vessel and its internals in PWR reactors. (auth)

2327 (SZS-162, pp 9-20) FRACTURE MECHANICS WITH REGARD TO STRESS CORROSION CRACKING OF THE PRIMARY COOLANT CIRCUIT OF NUCLEAR POWER PLANTS WITH PWR. Bergemann, W. Jun 1974. (In German).

It is derived that besides the critical crack length the definition of a critical leak propagation velocity is useful for those cases in which crack propagation is influenced by membrane stress as is the case with stress corrosion cracking. The critical leak propagation velocity results from the countercurrent effects of two factors: in the case of leak propagation the stress-intensity factor increases because of the increase of the leak or crack length, however decreases because of the pressure drop and hence of the decrease of membrane stress in the primary circuit. For simplification a monotonous exponential pressure drop is assumed. It was found that cracks caused by stress corrosion cracking are very improbable, at least with pipes of larger diameters, e.g., of more than 10. If a crack would occur it could be described as a "leak with fracture." 5 references. (auth)

2328 PWR FUEL FABRICATION. Seki, Y. (Mitsubishi Nuclear Fuel Co., Tokai, Japan). Karyoku Genshiryoku Hatsuden; 24: No. 5, 529-533(May 1973). (In Japanese).

In a PWR, the reactor core is generally divided in three regions according to fuel enrichment; however, the mechanical structure of fuel assemblies is the same in every region. Design, production, inspection, and the peculiarity in fabrication of PWR fuel are explained, and finally the Mitsubishi Nuclear Fuel Company is described. The fuel assemblies are produced by starting with UF_6, followed by the conversion to UO_2 powder and sintering in pellets, then fabrication into fuel rods, and finally taking the form of fuel assemblies. To obtain good performance in operation, inspection of the fuel is strict, and governmental inspection and ultrasonic defect detection are carried out. Peculiarity in the fuel production is related to the handling of uranium involved. (JA)

2329 THE FIRST INSPECTION AT THE STADE NUCLEAR POWER STATION. Goetz, A. (Nordwestdeutsche Kraftwerke A.G., Hamburg (F. R. Germany); Kernkraftwerk Stade G.m.b.H. (KKS) (F. R. Germany)). pp 10-18 of Nuclear Power Stations-Technology and Insurance. 7th Allianz Technical Colloquium on the 4th December, 1973 in Munich. Muenchen, F. R. Germany; Allianz(1974). (In German).

From 7th Allianz technical colloquium; Muenchen, F. R. Germany (4 Dec 1973). 15 figs.; 1 tab. With abstract in German, French, and English.

The experience gained in connection with the first inspection at the Stade Nuclear Power Station, which was carried out after 10,000 operating hours, is reported. Following a brief introduction into operations up to the first inspection, a description and elucidation is then given of the inspection planning and results. The success of the first operating cycle and the exceptional condition of the individual components give cause to anticipate continued favorable availability of the Stade Nuclear Power Station. (auth)

2330 MODEL EXPERIMENTATION AND ANALYSIS OF FLOW-INDUCED VIBRATIONS OF PWR INTERNALS. Dubourg, M.; Assedo, R.; Cauquelin, C. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92-Courbevoie (France)); Berriaud, C.; Livolant, M. (Cea Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). Nucl. Eng. Des.; 27: No. 3, 315-333(Jul 1974).

In a PWR the reactor coolant flow that goes through the reactor internals and the fuel assemblies is characterized by high turbulence and this flow is able to induce some structural vibration. A few years ago, some nuclear power plants were obliged to shut down for many months, due to the heavy damage caused by vibration. The design of reactors must be carefully checked taking into account the possible interaction between hydraulic excitation and reactor structure response. The SAFRAN test loop consists of a reduced-scale ($^1/_8$) model of a reactor vessel, reactor internals, dummies representing fuel assemblies and a system of three loops including pumps and damping tanks connected to the reactor vessel, the purpose of which is to simulate the flow distribution of a three-loop PWR. (auth)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 2318, 2325, 2425, and 2516-2519.

2331 (AED-CONF-74-044-003) HTR CONSTRUCTION PROJECTS AND DEVELOPMENT TRENDS. Brandes, S. (Hochtemperatur-Reaktorbau G.m.b.H., Mannheim (F. R. Germany)). 1974. 31p. (In German). INIS.

From exhibition and experts' meeting on nuclear technology; Frankfurt am Main, Germany (18 Mar 1974).

A survey of the THTR-300 project and the components of the plant is given. The next project of this type, the HTR-1160 plant, is also discussed. This demonstration nuclear power plant will be equipped with block-formed fuel elements. The special implications for direct cycle application are described. The development trends (HHT-project, process heat generation) of this line of reactors are discussed. (INIS)

2332 (AED-CONF-74-050-001) HIGH-TEMPERATURE REACTORS: STATE AND AIMS OF THE DEVELOPMENT. Dworak, A. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Projekt Hochtemperaturreaktor mit Heliumturbinen). 1974. 27p. (In German). INIS.

From seminar on invitation from the Oesterreichischer Verband fuer Elektrotechnik; Juelich, F. R. Germany (30 Jan 1974).

The setting up of the components of HTR dual-cycle plants is described, with emphasis laid on the fuel elements (spherical and block shaped). The HHT project (1,160 MW(e)) in dual-cycle or single-cycle plants as well as the potential use in process heat reactors are described. (INIS)

2333 (CEA-CONF-2600) REVIEW OF THE CHEMISTRY OF MOLTEN SALT REACTORS AND THE EQUILIBRIUM BETWEEN MOLTEN METAL AND SALTS. Dillon, I. G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). 1973. 109p. (CONF-730482-1). Dep. NTIS (US Sales Only) $8.50.

From meeting of the Department de Recherche et Analyse; Saclay, France (6 Apr 1973).

A look is given to various features that might be used for achieving thermal or fast molten salts reactors. Requirements for selection of fissionable salt, coolant salt and steam power systems are discussed. Description of various reprocessing systems, and of equilibriums between salts and fused metal are given for fluorides. The chemistry of equilibrium between liquid metal and molten chloride system is described. 147 references. (FR)

2334 (FRNC-CONF-101) NATURAL URANIUM–GAS–GRAPHITE FAMILY: GENERAL CHARACTERISTICS; OPERATING RESULTS; THE REASONS FOR ABANDONING IT. Roux, J. P. (Electricite de France, 93–Saint-Denis. Service de la Production Thermique). 1973. 18p. (In French). (CONF-730983-9). Dep. NTIS (US Sales Only) $4.00.

From Congress of the Society of Electrical, Electronic and Radio Engineers meeting; Vittel, France (11 Sep 1973).

The development and characteristics of the GCR type reactor are reported, and the construction period and costs associated with it are given. Production, availability and reasons for downtime in different countries are described. A note is given of the decrease in kWh costs as plant size rises and utilization improves, followed by an appraisal of the economic and technical factors that led to the abandonment of these reactors. (FR)

2335 (FRNC-CONF-112) HELIUM TURBINE FOR A HIGH TEMPERATURE DIRECT CYCLE NUCLEAR REACTOR. Chaboseau, J. (Compagnie Electro-Mecanique (CEM), 75 - Paris (France)). 1973. 21p. (In French). (CONF-730983-10). Dep. NTIS (US Sales Only) $4.25.

From Congress of the Society of Electrical, Electronic and Radio Engineers meeting; Vittel, France (11 Sep 1973).

The main functional and constructional characteristics of the turbine compressor are defined. First, the operating site is examined, followed by brief analysis of the Direct Cycle system. A comparison is then made of the aerodynamic properties of the working fluid in the helium turbine and those used in steam and combustion turbines, and then of the mode of soliciting operation of each type. There is a strong functional analogy between the steam and the helium turbines indicating that for the latter, it should be possible to adapt the well-proven technology of the combustion turbines used in thermal electricity generating plants. The marked influence of the choice regarding the layout of a direct cycle installation on the construction and operating facilities of the helium turbine is also noted. Although the problems seem fairly simple where there is one single-shaft turbine, they are more difficult for a multiple turbine installation, and even more so where twin-shaft turbines are involved. (FR)

2336 (JAERI-M-5633) DATA FOR DESIGN OF THE EXPERIMENTAL HTGR CORE. Core system and fuel element. Ikushima, T. (Japan Atomic Energy Research Inst., Tokyo). Mar 1974. 35p. (In Japanese). NTIS (US Sales Only).

Preliminary design of the experimental multipurpose HTGR was completed in 1971, and its conceptual design was started in 1973. The following core design studies are described: (1) thermal and stress analysis of the unit fuel lattice, (2) design examples of the core, and (3) design examples of the block type fuel element. (DG)

2337 (KFK–1931, pp 251-266) SOME CONSEQUENCES FROM THEORETICAL EVALUATIONS ON SPATIAL XENON TRANSIENTS IN HIGH TEMPERATURE REACTORS. Lauer, A. Jan 1974. (In German).

From experts meeting of the task groups thermodynamics and fluid dynamics and reactor physics of the KTG on requirements and present possibilities of predicting physics parameters of thermal and fast power reactors; Karlsruhe, F. R. Germany (29 Jan 1974).

21 figs.; 18 refs.

In status and requirements of the prediction of physical parameters for thermal and fast power reactors. P. 2. Reactor dynamics.

Xenon oscillations in high temperature reactors are discussed. The state of the art and the numerical problems of explicit simulation methods are described. Preliminary prediction results from trials in practice are reported. (GE)

2338 (ORNL-TM-4526) IRRADIATION PERFORMANCE OF HTGR FUEL RODS IN HFIR EXPERIMENT HRB-3 AND ETR EXPERIMENT P13N. Homan, F. J.; Coobs, J. H.; Conlin, J. A.; Long, E. L. Jr.; Hamner, R. L.; Montgomery, B. H.; Scott, J. L. (Oak Ridge National Lab., Tenn. (USA)). Oct 1974. Contract W-7405-eng-26. 62p. Dep. NTIS $5.45.

Strong-acid-resin fissile particles and thoria fertile particles were irradiated in HFIR experiment HRB-3 and ETR experiment P13N. The fuel irradiated in the P13N experiment was fully enriched (90.8% ^{235}U); the fuel irradiated in HRB-3 was 7.35% enriched. The fuel from both experiments performed well, considering the high operating temperatures. There was some attack of the inner LTI and SiC coatings by fission products in HRB-3, especially in the slug-injected specimens. The attack was not temperature gradient dependent. Migration of the ThO_2 fertile particle kernels was noted for the first time in the HRB-3 experiment. A small amount of migration was noted in the warm-molded specimens, but the migration was more pronounced in the slug-injected specimens with lower matrix density. In the P13N specimens considerable kernel migration was noted in the fissile particles, to the extent that numerous failures were seen. However, there was no migration of the ThO_2. These observations and data from previous experiments have led to the tentative conclusion that kernel migration has thresholds in temperature, temperature gradient, and burnup; and that once the thresholds are exceeded migration may occur very rapidly. The importance of the time parameter on kernel migration has not yet been fully evaluated. Data from real-time tests will be compared with data from accelerated tests such as HRB-3 and P13N to provide insight into the influence of this important parameter. (auth)

2339 (ORNL-TM-4705) ESTIMATES OF FISSION-PRODUCT INVENTORIES IN FUEL ELEMENT E06-01 OF THE PEACH BOTTOM CORE 2: RESULTS, COMPARISONS, AND SENSITIVITY STUDY. Tobias, M. (Oak Ridge National Lab., Tenn. (USA)). Oct. 1974. Contract W-7405-eng-26. 19p. Dep. NTIS $4.00.

The fission-product inventory of fuel element E06-01 of the Peach Bottom Core 2 has been estimated using the ORIGEN code to provide a theoretical basis for the present program of experimental measurements. The input numbers used, the results obtained, and a comparison with numbers provided by GAC for some of the fission-product nuclides are shown. The results of a study intended to show the sensitivity of ORIGEN calculations to the input data are also discussed. (auth)

2340 PARAMETERS INFLUENCING THE FLOW OF PACKINGS OF SPHERES AND NEAR SPHERES IN CYLINDRICAL VESSELS. Tingate, G. A. (AAEC Research Establishment, Sutherland, Australia). Nucl. Eng. Des.; 30: No. 1, 36-61(Jul 1974).

An experimental study has been made of some of the parameters governing the flow of pebbles in packed beds under the influence of gravity. The study centers on the flow of random packings of equal spheres in a cylindrical vessel with a conical hopper and a central outlet. The flow of regular concentric shell packings has also been investigated. Early experiments showed that flow patterns are unaffected by some of the parameters, including in particular the recirculation rate and interruptions of flow. This enables greatly simplified and accelerated experiments to be performed. Of about 30 parameters relevant to a recirculating pebble bed reactor, 13 can have major effects on the flow pattern. The experiments indicate that most of the effects stem from the hopper. Those which are undesirable in a nuclear reactor core, such as dead zones and high residence time ratios, can be eliminated or minimized by selecting appropriate values of the parameters. Further improvements can be effected by the provision of multiple hoppers and outlets. A velocity discontinuity is observed in the cylindrical portion of all random packings, whether the vessel is fitted with a hopper or not. With regular concentric shell packings several velocity discontinuities are possible. They are explained by a flow mechanism whereby pebbles continually make and break contact with the cylindrical wall and with one another. This confirms that most of the major effects on the flow pattern must stem from the hopper. (auth)

2341 REPLACING THE DRAGON'S REFLECTOR. Nucl. Eng. Int.; 19: No. 219, 667-670(Aug 1974).

The graphite columns running the full length of the Dragon reactor core formed the inner reflector and were designed to be replaced after 2 years. However, they remained in the reactor for over 6 years, during which time they became severely bowed under the influence of irradiation and temperature. The way in which this distortion, which in some cases resulted in broken tie-bars and bowing of control rod guide tubes, developed is described. The various stages of the operation to replace the reflector are explained. Included are the planning of the operation, the removal stage (which also involved removal of the control rods), a clean up, and the final reloading operation. The difficulties encountered at each stage and the resulting modifications are discussed. (UK)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstract 2414.

Power Reactors, Breeding

Refer also to abstracts 354, 2318, 2325, 2424, 2426–2428, 2430–2433, 2435–2458, 2460–2462, 2464, 2466–2486, 2488–2500, 2508, 2509, 2511, 2512, 2524, and 2564.

2342 (AEC-tr-7544) HIGH-POWER FAST REACTORS WITH COMBINED USE OF URANIUM-235 AND PLUTONIUM. Ilyunin, V. G.; Kuz'min, A. M.; Murogov, V. M.; Orlov, V. V.; Silaev, Yu. V.; Troyanov, M. F.; Shmelev, A. N.; Yurova, L. N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). [nd]. Translation of FEI-399. 28p. Dep. NTIS $4.50.

The characteristics of fast reactors using uranium-235 and plutonium are discussed. The results of computational studies are presented which demonstrate the effectiveness of using uranium-235 and plutonium in one reactor. (8 references) (auth)

2343 (AEC-tr-7549) METHODS OF CALCULATING HEAT EXCHANGE OF LIQUID METALS IN REGULAR LATTICES OF FUEL ELEMENTS AND SOME NEW EXPERIMENTAL DATA. Zhykov, A. V.; Matyukin, N. M.; Muzhanov, A. B.; Sviritsenko, E. Ya.; Ushakov, P. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). [nd]. Translation of FEI-404. 45p. Dep. NTIS $5.25.

A solution which is more general than those known from the literature for the problem of the temperature field of regular lattice of fuel elements with turbulent flow of coolants with Pr → 0 is presented. A simpler approximate solution is discussed which is recommended for practical calculations. An approximate semi-empirical solution is given for the problem of turbulent heat exchange in bundles of fuel elements which shows satisfactory agreement with experimental results. All of the solutions are based on simple relationships whose coefficients are given in tables and are plotted in the form of nomographs. New experimental data on the temperature fields of the rods and heat exchange in the bundle with S/d = 1.08 are discussed. A description is provided for an experimental bundle with methods of measurement and processing of experimental results. The results obtained are analyzed and compared with the calculations. 10 references. (auth)

2344 (AI-AEC-13131) ANNUAL TECHNICAL PROGRESS REPORT, FUELS, MATERIALS, AND CONTROL ROD DEVELOPMENT PROGRAMS GOVERNMENT FISCAL YEAR 1974. Garr, K. R.; Keefer, D. W.; Kramer, D.; Nakata, M. M.; Pard, A. G. (Atomics International Div., Canoga Park, Calif. (USA)). 30 Aug 1974. Contract AT(04-3)824. 78p. AT.

Progress is reported in the following areas: (1) irradiation damage studies in LMFBR cladding and core structural materials, (2) helium generation studies in reactor materials, and (3) control absorber heating experiments and calculations. (DG)

2345 (ANL-8091) BENCHMARK TESTING OF THE STRUCTURAL ANALYSIS IN THE LIFE-II FAST-REACTOR FUEL-ELEMENT CODE. Billone, M. C.; Jankus, V. Z. (Argonne National Lab., Ill. (USA)). Jun 1974. Contract W-31-109-eng-38. 27p. AT.

A set of benchmark problems is used to test the validity of the structural analysis in the LIFE-II fast-reactor fuel-element computer code. Analytical solutions are presented for the elastic and secondary creep response of isothermal, closed, thick-walled cylinders loaded by either internal or external pressure. The LIFE-II solutions for both cladding and fuel response are compared with the analytically derived solutions for these benchmark problems. The stresses, strains, and radial displacement predicted initially by the LIFE-II code match the analytical elastic solutions for these problems to within 1%. After a suitably long period of time, the LIFE-II stress solution approaches the steady-state plastic-stress distribution predicted by theory. In general, the code's long time stresses deviate from the analytical plastic stresses by <2%. The comparisons between the LIFE-II calculations and the analytical solutions are made for maximum accumulated plastic strains as high as 8% and for maximum creep rates of 2×10^{-3}% hr^{-1}. The results indicate that the LIFE-II code is performing elastic and plastic (i.e., creep) calculations for fuel elements with a reasonable degree of accuracy. (auth)

2346 (ANL-CT-75-04) GOVERNING EQUATIONS FOR THERMAL-HYDRAULIC MULTICHANNEL ANALYSIS USING TURBULENT TRANSPORT COEFFICIENTS. Sha, W. T.; Szewczyk, A. A. (Argonne National Lab., Ill. (USA)). Aug 1974. Contract W-31-109-Eng-38. 23p. AT.

Governing equations for thermal-hydraulic multichannel analysis using turbulent transport coefficients are developed and presented. Coefficients of eddy conductivity and eddy viscosity are used in the development of the energy and momentum equations. Because of the lack of information concerning eddy viscosity variation in the axial and transverse directions, it is assumed in the present formulation that the eddy viscosity will be defined to be the same for all directions under consideration. Also presented are recommended relationships defining eddy conductivity and eddy viscosity, and their variation with temperature and Reynold's number for liquid sodium. The formulation presented in this report will be implemented into the THI3D computer program. 4 references. (auth)

2347 (ANL/EBR-084) EBR-II BURNUP AND FLUENCE HISTORY I. Part 1. Method and Codes. Larson, H. A.; Walker, P.; Meneghetti, D. (Argonne National Lab., Ill. (USA); Argonne National Lab., Idaho Falls, Idaho (USA)). May 1974. Contract W-31-109-eng-38. 58p. Dep. NTIS $6.00.

The methods and codes that were used to calculate a chronological history of burnup and fluence for EBR-II are described to provide a users' guide to the method and the interrelationships of the program modules. Isotopic depletions and buildups are obtained using a system of computer programs based on the DOT transport code and the REBUS fuel-cycle modules of the ARC (Argonne Reactor Computation) system. A cumulative file of volume fractions and fluences is maintained. These data, along with volume fractions for newly added subassemblies, are input for calculations of the reactor run next in chronological order. Thus, any driver-fuel or experimental subassembly may be followed throughout its history in the reactor. (auth)

2348 (ANL-RDP-30) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, JULY 1974. Argonne National Lab., Ill. (USA)). 29 Aug 1974. Contract W-31-109-eng-38. 146p. AT.

Progress is reported in the following areas: EBR-2 operations and testing; LMFBR design support; instrumentation and control; fuels and materials development; reactor physics; reactor safety; GCFR critical experiments and safety aspects; and irradiation behavior of carbide fuel. (DCC)

2349 (ANL-RDP-31) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, AUGUST 1974. (Argonne National Lab., Ill. (USA)). 27 Sep 1974. Contract W-31-109-Eng-38. vp. AT.

Progress is reported in the following areas: EBR-2 operations and analysis; LMFBR design support; instrumentation and control; fuels and materials development; reactor physics; reactor safety; GCFR safety aspects; and irradiation behavior of carbide fuel. (DCC)

2350 (CONF-740401-P1, pp 3-28) SAFETY RELATED CRITERIA AND DESIGN FEATURES FOR SNR. Huebel, H. J. (INTERATOM, Bensberg, Ger.). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The SNR 300 is under construction near Kalkar on the lower Rhine river. During the completed part of the licensing procedure two classes of requirements have had the greatest impact on the power plant: the diversification and extensive redundancy of the installations for the dissipation of the decay heat; and the provision of a two-stage defense line against HCDA's. The requirements of the licensing authority and the design measures to fulfill them are described. Difficulties in establishing specific technical solutions are pointed out. (auth)

2351 (CONF-740401-P1, pp 29-50) SUPER-PHENIX PRELIMINARY SAFETY ANALYSIS; GENERAL RELATED CRITERIA AND MAIN FEATURES. Megy, J.; Leduc, J.; Chdiot, A.; Giudicelli, A.; Robert, E.; Rodet, E.; Crette, J. P.; Malaval, C. 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The first realization of the SUPER-PHENIX nuclear plant is to take place in the CREYS-MALVILLE Plant. It will be found here a brief description of the plant, highlighting safety characteristics; then there shall be some developments regarding protection taken against missiles, earthquakes, sodium fires, sodium/water reactions; moreover, containment is defined; lastly, waste criteria and irradiated fuel subassembly shipping conditions are discussed. (auth)

2352 (CONF-740401-P1, pp 51-71) SELECTION OF SAFETY DESIGN BASES FOR MONJU. Terata, K.; Saito, T.; Nishikawa, Y. (Power Reactor and Nuclear Fuel Development Corp., Tokyo). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

MONJU is the prototype fast breeder reactor, succeeding the experimental fast reactor JOYO being under construction. The philosophy in performing the safety design of the LMFBR in general and specifically of MONJU is described. The general safety philosophy and procedures for the LMFBR are discussed. The selection of the safety design bases for MONJU is discussed. Specific safety design criteria and features adopted for MONJU are presented. (auth)

2353 (CONF-740401-P1, pp 136-150) WASTAGE OF STEAM GENERATOR TUBES DURING SMALL LEAK OF STEAM INTO SODIUM. Nei, H.; Ujihara, K.; Ohshima, I.; Hori, M. (Power Reactor and Nuclear Fuel Development Corp., Tokyo). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

Material wastage tests with steam injections into sodium have been performed. The following test conditions were kept constant: sodium velocity past target, 0.24 m/sec; nozzle-to-target spacing, 17.5 mm. The effects of leak rate and sodium temperature were examined over a range of 0.07 to 7 g/sec and 270 to 540°C using 2-1/4Cr-1Mo steel and stainless steel as a target material. An experimental equation was presented to predict the wastage rate as a function of the leak rate and the sodium temperature. The wastage rate is increased exponentially by increasing the sodium temperature. The difference in the wastage rates between steam and water, which had been stated generally, was considered to depend mainly on the difference in the sodium temperature. Stainless steel was more resistant to wastage by factor of about 5 over 2-1/4Cr-1Mo steel at the sodium temperature of 480°C. The difference was considerably smaller than those that had been reported elsewhere. Inspection of the contour map and sectional view of wastage area showed that the depth distribution was expressed by a normal curve of error for most range of leak rate tested. Tube penetration tests were conducted to evaluate the size of penetration hole on the target tube. A process of the propagation of tube failure was discussed assuming the depth distribution of wastage area. 12 references. (auth)

2354 (CONF-740401-P1, pp 151-161) PRELIMINARY RESULTS FROM SMALL LEAK TUBE WASTAGE SCOPING TESTS. Greene, D. A. (General Electric Co., Sunnyvale, CA). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

An interim preliminary report on the scoping wastage experiments performed in the GE/SOWAT sodium-water wastage test facility is presented. The facilities and test procedure are described. Test data from the first test series, approximately two dozen tests, are given. Initial results from these scoping tests indicate the wastage damage is a strong function of injection rate, sodium temperature, and material. (auth)

2355 (CONF-740401-P1, pp 162-172) USE OF IN-SODIUM HYDROGEN DETECTORS DURING STEAM GENERATOR TESTS IN THE SCTI. McKee, J. M. (Argonne National Lab., IL); Pohl, L. E. 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

Two hydrogen detectors were installed in the secondary sodium system of the Sodium Components Test Installation (SCTI) for detecting steam-to-sodium leaks during testing of a Modular Steam Generator (MSG). The steady-state hydrogen content of the sodium ranged typically from 40 ppb at zero power to 80 ppb at 30 MW(t). The increase above saturation at the cold-trap temperature gave a measure of the rate of hydrogen input to the sodium, primarily from water-side corrosion of the MSG tubes. The hydrogen flux diffusing through the tube walls after a month of full-power operation was $\sim 9.4 \times 10^{-12}$ g H/(cm^2)(sec). In the Clinch River Breeder Reactor Plant, that flux could choke the secondary cold traps with sodium hydride in 1-2 yr. Operating experience indicated that the effective sensitivity of such leak detection systems will be determined by the rate-of-rise alarm settings and limited by non-leak variations in the hydrogen content of the sodium. In the MSG test such variations did not exceed 0.1 ppb H/min except when first raising steam. The smallest rate-of-rise which would have given an alarm on the SCTI detectors was 2 ppb H/min, equivalent to a leak in the MSG of 10^{-5} lb H_2O/sec. Alarm on a rise rate of 0.34 ppb H/min appears to be feasible without excessive incidence of non-leak alarms. In the Clinch River Plant that would be equivalent to a leak rate of 2×10^{-5} lb H_2O/sec. 12 references. (auth)

2356 (CONF-740401-P1, pp 173-187) ACOUSTIC DETECTION FOR SMALL-LEAK SODIUM-WATER REACTION. Nei, H.; Ohshima, I.; Ujihara, K.; Hori, M. (Power Reactor and Nuclear Fuel Development Corp., Tokyo). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

Characteristics of the sounds generated by sodium-water reaction and applicability of the acoustic detection system to the small water leak was investigated. The measurement of the RMS value and the analysis of the frequency of the sound signals was conducted. It was found that in our loop the small leak of water into sodium, as small as 0.07 grams steam per second, was able to be detected by RMS meter. It was also found that the peaks of a frequency spectrum of the sound generated by sodium-water reaction were caused by the natural vibrations of a rod or tube on which an acoustic transducer was mounted, and that the RMS value averaged over the water injection period was approximately proportional to the one-third power of the water leak rate and was considerably affected by ambient sodium temperature. 12 references. (auth)

2357 (CONF-740401-P1, pp 188-202) STUDY OF THE EFFECTS OF SMALL LEAKAGE OF WATER INTO THE SODIUM OF A STEAM GENERATOR. Lions, M. N.; Biscarel, J.; Lafon, A.; Chedeville, C.; Ferretti, G. (CEN, Cadarache, France). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The wastage effects of small water or steam leakage into sodium are studied in the PHENIX steam generator geometry. These tests reveal the operational safety of the steam generators. (auth)

2358 (CONF-740401-P1, pp 461-472) EXPERIMENTS ON FILTRATION OF SODIUM-AEROSOLS BY SAND-BED-FILTERS. Boehm, L.; Jordan, S.; Schikarski, W. (Kernforschungszentrum, Karlsruhe, Ger.). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

Nuclear installations with the chance of accidental sodium fires have been equipped so far by the conventional fiber filters consisting of glass fibers with small diameters in the range of 0.1 to 0.3 μm. These HEPA filters have been demonstrated to provide retention efficiencies for all sizes of aerosols up to 99.99% and more for low concentrations of almost chemical inert aerosols. Little information is available on the behaviour of these fiber filters if high concentrations of chemical aggressive aerosols are to be removed from off-gas streams. In the Nuclear Research Center Karlsruhe a program is under way which aims at the following goals: testing of commercial fiber glass filter elements for removal of sodium aerosols; determination of performance of fiber glass filters in the typical environment of a LMFBR containment encountered in an accidental spill of sodium; development of sand-bed filters to be used in Liquid Metal Fast Breeder Plants; testing of these sand-bed filters by operation in the typical environment of a LMFBR containment encountered in an accident connected with major sodium spills; and optimization of the design and performance of the filter according to the normal and accident conditions in the LMFBR plant. (auth)

2359 (CONF-740401-P2, pp 1009-1020) PHENIX STARTUP. Carle, R.; Megy, J.; Guillemard, B.; Robert, E.; LeMarechal, T.; Crette, J. P.; Labat, P. 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The PHENIX 250 MW Prototype Fast Reactor Power Station reached nominal power on March 12, 1974. The startup tests which began at the end of 1972 are described. Both anticipated sequencing and actual sequencing are given for each test phase. Main results and encountered difficulties are reported. (auth)

2360 (CONF-740401-P3, pp 1349-1369) DIVERSE SHUTDOWN SYSTEMS FOR THE KNK-1, KNK-2, AND SNR-300 REACTORS. Morgenstern, F. H.; Buchholz, H.; Krueger, H.; Roehrs, H. (INTERATOM, Bensberg, Ger.). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The situation of KNK-1, in which a second fast acting shutdown system was strongly required by the authorities, was very unfavorable due to the advanced stage of construction. The available time could be utilized only to develop and install a mechanical system. Herewith a second shutdown system was predetermined for KNK-2, which has been modified within the mechanical part only a little. The availability of a functioning system and the open-ended development expenses, obvious from studies of a liquid absorber system, resulted in the decision to consider the already developed system as a basic design for the SNR-300, too. This decision was supported by the fact that it was impossible to define specific criteria for the general demand for diversity. The degree of diversity and independence achieved in the whole safety system including the shutdown systems, however, seems to be sufficient with respect to the very remote probability of a subassembly event intolerably damaging the absorber guide tubes of both shutdown systems, sufficient in the sense of an overall reliability. (auth)

2361 (CONF-740401-P3, pp 1370-1378) CONSIDERATIONS RELATIVE TO A BACK-UP SYSTEM. Clauzon, M. P.; Mar-

monier, P.; Meyer Heine, A.; Ladet, J.; Cachera, P.; Delemontey, J. 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The interest of a back-up system is analyzed. In the first part a description of the classical safety system of Phenix is given, then the specifications of a back-up system are listed in a second part. Different possible solutions are examined. (auth)

2362 (CONF-740401-P3, pp 1379-1392) LMFBR ALTERNATE SHUTDOWN SYSTEMS: TEST EXPERIENCE AND GENERAL DESIGN CRITERIA. Noyes, R. C.; Gilbertson, J. C. (Combustion Engineering, Inc., Windsor, CT). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

A brief review of the history of alternate shutdown systems for LMFBR's is presented together with a discussion of the rationale used in developing six proposed general design criteria for such systems. A reactor shutdown system developed at Combustion Engineering, Inc. is described which uses a modified EBR-II type control rod system with a redundant second system similar to FERMI safety rods except that the scram mechanism is pneumatically actuated. Test results of a model of the pneumatic scram release mechanism operated in sodium at 1100°F are given. (auth)

2363 (CONF-740401-P3, pp 1393-1399) ALTERNATE SHUTDOWN SYSTEM DEVELOPMENT PROGRAM. McKeehan, E. R.; Shawver, B. M. (General Electric Co., Sunnyvale, CA). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

An alternate shutdown system development program is described. The system being developed is for application to the Liquid Metal Fast Breeder Reactor (LMFBR) and serves as a backup to the primary shutdown system. The system is discussed, and component development tests are outlined. (auth)

2364 (CONF-740401-P3, pp 1400-1412) GCFR's SOLUTION TO RADIATION AND THERMAL DISTORTION. Hopkins, H. C.; Snyder, H. J. Jr. (General Atomic Co., San Diego, CA). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The design features of the Gas-Cooled Fast Breeder Reactor (GCFR) that allow accommodation of radiation and thermal distortion without resorting to a complex core-restraint mechanism are discussed. A comparison of radiation swelling and geometric parameters for the GCFR and LMFBR are presented to illustrate why a restraint system is unnecessary. The analysis of GCFR core behavior is described briefly. (auth)

2365 (CONF-740401-P3, pp 1415-1429) SINGLE SUBASSEMBLY FAULT DETECTION SYSTEM: FUNCTIONAL REQUIREMENTS AND SHUT-OFF CRITERIA. Gast, K.; Smidt, D. (Kernforschungszentrum, Karlsruhe, Ger.). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

Considering potential modes of single subassembly fault propagation, the critical chain of events is identified. Several stages of fault development are distinguished and the relevant phenomena are discussed with regard to their potential of causing damage, their time scale of progression and methods of detection. Preliminary functional requirements are derived for the subassembly fault detection system. Finally, a set of alarm and shut-off criteria is presented as an example. 18 references. (auth)

2366 (CONF-740401-P3, pp 1430-1445) ROLE AND DEVELOPMENT OF LMFBR PROTECTION SYSTEMS. van Erp, J. B.; Fauske, H. K. (Argonne National Lab., IL). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

It is recommended that a balanced approach be followed with respect to reliance on (1) reactor safety shutdown systems (plant protection systems), and (2) engineered safeguards, for protection of public health and safety: reactor safety shutdown systems, as well as engineered safeguards (containment systems, blast shields, post-accident-heat-removal systems, etc.) of high reliability and proven performance should be provided for fast breeder reactors. Inherent safety for hypothetical core-disassembly events, obtained predominantly by means of passive engineered safeguards, should remain a long-range goal in the development of fast breeder reactors. For the short-term future, upper values of energy releases and destructive work, relative to hypothetical core disassembly accidents assumed as design bases for engineered safeguards, should be established on the basis of what is, for a particular plant, expected to be a reasonably provable high limit in the light of the present state of knowledge and the expected results from ongoing and near-future research, rather than on the basis of what could possibly be calculated as an extreme upper limit by following accident scenarios, obtained by compounding numerous improbable and very conservative assumptions. Such an approach will require the development of plant protection systems of high reliability and proven performance, having, at all levels, adequate characteristics of redundancy, diversity, and insensitivity to common-mode failures. 27 references. (auth)

2367 (CONF-740401-P3, pp 1446-1451) LMFBR SAFETY INSTRUMENTATION. Hikido, K.; Meyer, R. A.; Regimbal, J. J. (General Electric Co., Sunnyvale, CA). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The status of LMFBR safety instrumentation is reviewed with emphasis on in-vessel sensors which may be employed to avoid conditions leading to possible fuel failure propagation. Focus is placed on core-exit temperature and flow sensors, acoustic monitors, and FEDAL equipment planned for FFTF and the CRBRP. Special emphasis is given to possible instrumentation requirements based on data from failed fuel swelling measurements. Additional development work relating to instrumentation required for operation with failed fuel is suggested. (auth)

2368 (CONF-740401-P3, pp 1481-1492) EVALUATION OF THE PROBABILITY OF AN AIRCRAFT CRASH ON A NUCLEAR POWER PLANT. Cravero, M.; Lucenet, G. 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The liquid Metal Fast Breeder Reactor SUPER-PHENIX, (electrical power 1200 MW) which will be built at CREYS-MALVILLE in the Rhône valley must follow the guidelines given in France for the safety of this reactor. One of these guidelines is to evaluate the risks in relation with air traffic. Consequently, a study of this problem was begun to estimate the probability of an aircraft crash on the power plant SUPER-PHENIX, particularly on reactor building. 20 references. (auth)

2369 (CONF-740401-P3, pp 1508-1521) ESTIMATE OF LMFBR STEAM GENERATOR SYSTEM RELIABILITY AND AVAILABILITY. Brown, N. W.; Stitt, R. K.; Wilson, R. J. (General Electric Co., Sunnyvale, CA). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

A probabilistic evaluation of a reference steam generator system is discussed. The study was conducted in support of the AEC LMFBR Steam Generator Systems Development Program. The objective of the study was to help in identifying the relative importance of critical development areas. The study estimates the probability of structural damage to the secondary sodium system boundary and the availability of a single loop of a three loop reference plant. Critical development needs and their relative importance to reliability and availability goals are identified based on the probabilistic evaluations. 12 references. (auth)

2370 (DEU-73-23) NUCLEAR POWER PLANT KALKAR. (Projektgesellschaft Schneller Brueter G.b.R., Essen (F. R. Germany); Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bensberg/Koeln (F. R. Germany); Societe Belge pour l'Industrie Nucleaire, Brussels; Neratoom N. V., The Hague (Netherlands)). [nd]. 34p. (In German).

In order to demonstrate the operating safety and economy of LMFBR power plants, a prototype of a fast sodium cooled reactor (SNR) for the nuclear power plant Kalkar has been developed by the SNR association with considerable financial support from the government of the Federal Republic of Germany, the Kingdom of Belgium and the Kingdom of the Netherlands. This reactor has a thermal capacity of some 730 MW, which can be increased later. An area of land held by the community Kalkar on the lower Rhine has been proposed as a site for the nuclear power plant. The state of the work and the concept of the finished plant are described. (GE)

2371 (EURFNR-1153) FAST BREEDER REPORT. Fourth Quarterly Report, October 1-December 31, 1973. (Kernforschungszentrum Karlsruhe (F.R. Germany)). 1973. Translation of KFK-1273/4. 236p. Dep. NTIS $5.45.

Work performed under United States-Euratom Fast Reactor Exchange Program.

Information on the development of fast breeder reactors in the German Federal Republic is presented concerning fuel pin per-

formance testing, materials studies, corrosion tests, fuel cycle analysis, reactor physics, safety aspects, and reactor component development. (DCC)

2372 (EURFNR-1208) PHYSICS INVESTIGATIONS OF SODIUM COOLED FAST REACTORS: SNEAK-ASSEMBLY 9B. Part 1. Jourdan, G. (comp.). (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Systemtechnik und Reaktorphysik). Jul 1974. 31p. (KFK-2012). Dep. NTIS (US Sales Only) $4.75.

Work performed under United States–Euratom Fast Reactor Exchange Program.

SNEAK-9B was one modification of the series of assemblies SNEAK-9, which were designed for investigating important physics parameters of a sodium cooled fast core of the SNR-type. Of particular interest in SNEAK-9B were reaction rate measurements in the core and blanket zones to calculate the breeding ratio. Other important measurements were large sodium void and absorber worth measurements. SNEAK-9B consisted of a cylindrical core with two core zones. The central zone was fueled with plutonium. The outer zone was uranium driver zone followed by a blanket zone. (auth)

2373 (EURFNR-1209) PHYSICS INVESTIGATIONS OF SODIUM COOLED FAST REACTORS: SNEAK-ASSEMBLY 9A. Pinter, M. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Systemtechnik und Reaktorphysik). Jul 1974. 37p. (KFK-2028). Dep. NTIS (US Sales Only) $5.00.

Work performed under United States–Euratom Fast Reactor Exchange Program.

SNEAK-9A was a mock up of the SNR with two core zones in radial direction. The fuel material was enriched uranium. The main objectives were criticality prediction, determination of the control rod worth, and the measurement of the power distribution. The assembly was built up in three steps: SNEAK-9A-0, a clean core; SNEAK-9A-1, a core with 12 simulated control rods filled with sodium follower material; and SNEAK-9A-2, the final mock up core with control rods partially inserted. The results of the criticality, reaction rate, and reactivity worth measurements are given. (auth)

2374 (GEAP-10028-50) CORE ENGINEERING. Fiftieth Quarterly Report, February–April 1974. (General Electric Co., Sunnyvale, Calif. (USA). Advanced Technology Dept.). May 1974. Contract AT(04-3)-893. 93p. AT.

Progress is described for tasks related to fuel rods, fuel rod assemblies, core restraint, and control and blanket assemblies. (auth)

2375 (KFK-1274/1) FAST BREEDER PROJECT. First Quarterly Report, 1974. Hueper, R. (comp.). (Kernforschungszentrum Karlsruhe (F. R. Germany)). Jun 1974. 137p. (In German). (EUR-4976d). Dep. NTIS (US Sales Only) $10.00.

Information on the development of fast breeder reactors in the German Federal Republic is presented concerning fuel pin performance testing, materials studies, corrosion tests, fuel cycle analysis, and safety aspects. (DCC)

2376 (ORNL-TM-4597) DYNAMIC EXPERIMENTS FOR HEAT TRANSFER AND MIXING STUDIES IN LMFBR FUEL ASSEMBLIES. Wilson, D. W.; Kerlin, T. W. (Oak Ridge National Lab., Tenn. (USA)). Jun 1974. 165p. Dep. NTIS $7.60.

Dynamic experiments were performed on an electrically heated mockup of a Liquid Metal Fast Breeder Reactor (LMFBR) fuel assembly (the Fuel Failure Mockup at Oak Ridge National Laboratory) to determine the temperature-to-power frequency response. The experimental frequency response results were analyzed and interpreted to give information on flow and heat transfer patterns in the fuel assembly. The experimental frequency response was obtained by perturbing the power supplied to a single heated rod in the 19 rod assembly with a pseudo-random binary sequence signal and then analyzing simultaneously the input signal and the resultant output temperature signals measured at several points in the assembly. Simplified theoretical models were used to aid in interpreting the results. One model was based on an assumption of well mixed flow and the other on slug flow. A method was developed to provide information on energy flow patterns. Preliminary use of this method clearly showed the presence of edge swirl effects and the dependency of edge swirl on the smoothness of the can that contained the test section. Additional analysis showed that slug flow could be distinguished from well mixed flow and that slug flow was predominant at the beginning of the heated section and well mixed flow was predominant at the exit of the heated section. (auth)

2377 (ORNL-TM-4642) USER'S MANUAL FOR ORNL CREEP-PLAST GRAPHICS PACKAGE. Fowler, P. G.; Crowell, J. S.; Clinard, J. A. (Oak Ridge National Lab., Tenn. (USA)). Sep 1974. Contract W-7405-eng-26. 47p. Dep. NTIS $5.45.

Necessary user information to implement and use a graphics package for the ORNL version of CREEP-PLAST is presented. Complete input instructions are provided. Sample input and output are given in two appendices. (auth)

2378 (RT/ING-(74)17) BOILING HEAT TRANSFER IN LMFBR STEAM GENERATORS. Campolunghi, F.; Cumo, M.; Ferrari, G.; Vaccaro, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Jun 1974. 39p. Dep. NTIS (US Sales Only) $5.00.

The prediction of the surface heat flux in the boiling region of sodium-heated once-through steam generators requires the employment of forced-convection boiling heat transfer correlations. On one side, the overall extension of the boiling region, i.e., from the point of zero-quality to the point of burnout or dryout covers a considerable extension of the whole length, so becoming a determinating factor in the thermal design and in the capital costs, on the other, a very great spread does exist among the predictions of the available correlations. So an extensive, experimental research has been performed in full scale, employing long and vertical tubular ducts (L = 11 m; D = 12 mm), uniformly heated by Joule effect, in a pressure range from 60 to 160 kg/cm^2. The available, experimental data have been tested systematically against well known correlations, so deducing useful informations for the thermal design. 7 references. (auth)

2379 (RT/ING-(74) 18) HEAT TRANSFER TO DRY AND SUPERHEATED STEAM IN ONCE-THROUGH GENERATORS FOR LMFBR'S. Campolunghi, F.; Cumo, M.; Ferrari, G.; Vaccaro, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Jun 1974. 29p. Dep. NTIS (US Sales Only) $4.50.

The design of once-through steam generators, with particular reference to sodium heated steam generators for fast breeder reactor plants, requires the employ of reliable heat transfer correlations for dry and superheated steam. A considerable portion of the steam generator itself is cooled by dry steam which gradually superheats up to the maximum temperatures allowed by present technologies, so that uncertainties in the thermal design reflect on plant costs. The comparison among the existing correlations, often deduced from experimental data obtained with short and "laboratory scale" test sections, shows discrepancy in theoretical predictions. So, full scale tests data seem the only way to attain reliable heat transfer correlations. The present work describes such tests and shows the experimental data obtained. From the data heat transfer correlations for the superheated steam have been deduced, which are proposed for steam generator design. 11 references. (auth)

2380 ANALYTICAL STRESS ANALYSIS SOLUTION FOR A SIMPLIFIED MODEL OF A REACTOR FUEL ELEMENT. Lamkin, D. E. Tucson; Univ. of Arizona, Tucson (1974). 112p. University Microfilms Order No. 74-19,490.

Thesis (Ph. D.).

A simplified mathematical model for fuel element stress analysis is proposed. The principal idealizations introduced are: 1. The fuel element is represented geometrically by one fuel region surrounded by a cladding region. 2. Mechanical properties are taken to be space independent within each of the two regions. 3. Creep rates are assumed to be related linearly to the deviatoric stress. 4. A state of plane strain with azimuthal symmetry is assumed. Using the method of the viscoelastic-elastic analogy, closed-form analytical solutions to this model are obtained giving the stresses in the fuel element. Based upon this analytical solution, a numerical evaluation of the cladding stresses for a typical LMFBR fuel element is undertaken. For the properties and geometry selected, it is found that no fuel-cladding interaction develops. Also, the major stress producing mechanism is identified to be the spatial variation of the stainless steel swelling through the cladding wall. It is further found that irradiation creep produces a considerable relaxation of the cladding stresses. In order to examine the effect of a fuel-cladding interaction pressure, and also to exercise the full capability of the analytical solution, a second numerical evaluation is carried out with a lower fluence to burnup ratio. It is found that the fuel-cladding interaction results in much higher cladding stresses. (Diss. Abstr. Int., B)

2381 METHOD OF MAKING FUEL AND FERTILE ELEMENTS FOR NUCLEAR-REACTOR CORES. Gyarmati, E.; Nickel, H. (to Kernforschungsanlage Juelich Gesellschaft mit beschrankter). US Patent 3,833,470. 3 Sep 1974. Priority Date 27 Jun 1969, F. R. Germany. 6p.

A method of making fissionable-fuel or fertile elements for the core of a nuclear reactor, especially a reactor of the gas-cooled type is described, wherein the fuel or fertile material is introduced into graphite shells in the form of coated particles and a pyrolytically decomposable carbon-containing or silane gas is passed upwardly through the shell while the mass therein is heated by displacing an induction-furnace core downwardly around

the graphite shell thereby bonding the coated particles together with pyrolytic carbon, silicon carbide or zirconium carbide being formed in situ to yield a coherent mass with a porosity of, say, 10 to 25 percent. The gas is preferably a mixture of one or more inert gases (nitrogen, argon or helium) with one or more hydrocarbons or carbon-containing gases (e.g., methane, acetylene, benzene, or silanes). (Official Gazette)

2382 BREEDER REACTORS: THE PHYSICIST'S CONTRIBUTION. Dyos, M. W. (Westinghouse Electric Corp., Madison, PA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 19, 175-181(1974).

From topical conference on energy; Chicago, Illinois, USA (4 Feb 1974). See CONF-740201-.

The use of experimental and development programs, nuclear data, integral experiments, calculational methods, and commercial reactor studies for developing the physics aspects of LMFBR reactors is discussed. (DCC)

2383 COOLANT FLOW AND REACTIVITY OSCILLATIONS. Lu, Y. S. (General Electric Co., Sunnyvale, CA). Contract AT(04-3)-540. Nucl. Sci. Eng.; 55: No. 3, 249-255(Nov 1974).

The theoretical linear reactivity feedback model is analyzed and it is shown that the separate oscillations of reactivity, primary coolant flow, and secondary coolant flow provide valuable information such as the fuel power reactivity coefficient, the fuel temperature coefficient, and heat transfer characteristics between fuel and coolant. (auth)

2384 MULTIREGION EQUIVALENCE RELATION FOR RESONANCE HETEROGENEITY EFFECTS. Ishiguro, Y. (Japan Atomic Energy Research Inst., Tokai). Nucl. Sci. Eng.; 55: No. 3, 349-351(Nov 1974).

To provide a convenient and reliable method for estimating resonance heterogeneity effects, a multiregion equivalence relation is derived for fast reactor lattice cells. It is shown that the broad group cross sections of "each plate" in a multiregion problem can be calculated by using a cross-section set of the Bondarenko type. Moreover, for the special cases where the thickness of all the resonance plates is equal, the formulation is shown to be equivalent to the two-sided E_3 formulation of Meneghetti. (auth)

2385 CALCULATION METHODS IN THE UTILIZATION OF THE GAME THEORY FOR THE INITIAL BREEDING OPTIMIZATION OF MULTIZONAL FAST REACTORS. Pavelescu, M. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz., 25: No. 6, 673-704(1973). (In Rumanian).

The following topics are discussed: (1) non-zero sum game with two partners in reactor physics, (2) numerical calculation method of fast reactors in the transport approximation of the neutron transport equation, (3) general considerations, (4) Boltzmann equation, (5) transport approximation of Boltzmann equation, (6) multigroup treatment, (7) methods of solving the multigroup equation set, (8) difference equations, (9) discretization of the angular variable, (10) discretization of the radial variable, (11) solving the difference-coupled equation set, (12) algorithm for reactors with two components, and (13) algorithm for reactors with five components. (auth)

2386 CALCULATION OF DOSES FROM FAST-REACTOR RADIATION LOOPS. Rudoi, V. A.; Vetrov, E. M.; Breger, A. Kh.; Polyanskii, N. I.; Tikhonov, V. P. Sov. J. At. Energy (Engl. Transl.); 36: No. 2, 162-163(Feb 1974).

Translated from At. Energ. (USSR); 36: No. 2, 133(Feb 1974).

A method is proposed for the calculation of the absorbed gamma dose rate at a point above a plane rectangular radiating surface. Results obtained by the method show satisfactory agreement with experimental measurements. (DG)

Research, Test, and Experimental Reactors

Refer also to abstracts 2348, 2349, 2360, 2374, 2434, 2442, 2487, 2510, 2531, and 2532.

2387 (AED-CONF-74-066-005) EXPERIENCE GAINED DURING THE COMMISSIONING OF KNK I AND PREPARATORY WORK FOR THE RECONSTRUCTION OF KNK I TO KNK II. Status Report of the Projekt Schneller Brueter. Marth, W. (Kernforschungszentrum Karlsruhe (F. R. Germany)). 1974. 8p. (In German). INIS.

Following a comparison of the KNK I with similar plants, an account is given of the various difficulties and incidents that caused the delay in the commissioning of the plant, which finally started full-load operation on February 21, 1974. The reasons underlying the planned reconstruction of the KNK I to KNK II are given, along with a brief report on the present state of this project. (INIS)

2388 (ANL-8100) TREAT MARK-II-LOOP TESTS D1 AND D2 ON LOCALLY OVERENRICHED FUEL PINS. Palm, R. G.; Deitrich, L. W.; Murphy, W. F.; Stanford, G. S. (Argonne National Lab., Ill. (USA)). May 1974. Contract W-31-109-Eng-38. 85p. AT.

Results and analysis are presented of TREAT Tests D1 and D2. These tests addressed failure of fuel pins having local overenrichment, and were conducted using a Mark-II flowing-sodium loop and a seven-pin cluster of FFTF-like pins. Fuel-pin failure did not occur in either test in spite of substantial local fuel melting. An analysis of the test conditions and of the fuel pins after the test is presented. Reasons for the lack of pin failure are discussed. 10 references. (auth)

2389 (CNAEM-R-121) SYSTEM FOR THE DETECTION OF CLADDING RUPTURE BY DELAYED NEUTRONS APPLICABLE TO LIGHT WATER REACTORS. Erk, S. (Cekmece Nuclear Research Center, Istanbul (Turkey)). 1973. 89p. (In French). Dep. NTIS (US Sales Only) $7.50.

One of the most important safety systems of reactors is the cladding rupture detector controlling the integrity of the cladding of fuel elements. Among the new methods used in cladding rupture systems, that of the detection of delayed neutrons seems particularly well adapted to research reactors of the swimming pool and water-cooled type. The principle of the detection of the first and second group of delayed neutrons from fission products is proposed as quite suitable for such a system. Both theoretical and practical methods necessary for the development of such a system are developed. A detection device for fuel rupture developed for the TR-1 reactor is described in detail. It was established that there is satisfactory agreement between the measurement results obtained with it and the results of calculations made on theoretical bases. (tr-auth)

2390 (CONF-740401-P1, pp 205-219) REVIEW OF TREAT EXPERIMENTS IN SUPPORT OF TRANSIENT OVERPOWER (TOP) ANALYSIS FOR FAST REACTOR SAFETY. Rothman, A. B.; Deitrich, L. W.; Doerner, R. C.; Wright, A. E.; Dickerman, C. E. (Argonne National Lab., IL). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The results of nine Fuel Dynamics TREAT experiments conducted over the past five years in support of analysis of the hypothetical Transient Overpower (TOP) accident in the Fast Test Reactor (FTR) are presented. The physical features of each test are discussed, and the most significant results bearing on key safety issues are presented. Finally, the non-prototypic aspects of each test are summarized and conclusions are drawn. All the tests discussed were conducted with oxide fuel elements in a flowing sodium environment provided by the Mark-II loop. Sample sizes were 1 to 7 pins. Analysis of early tests has been reviewed and updated using the latest analytical tools, and the results, along with those for later tests, are presented. 7 references. (auth)

2391 (COO-1560-7B) CORE TEST PROGRAM: UWNR MIXED TRIGA-FLIP CORE. Cashwell, R. J. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). Jul 1974. 27p. Dep. NTIS $4.50.

Criticality experiments and reactivity measurements are described together with power escalation and calibration studies, pulsing tests, and full power measurements of fuel and coolant temperatures and flux distribution. (DG)

2392 (GSF-P-33) GUIDELINES FOR IRRADIATION TESTS AT THE FRN. Grundler, W.; Rau, G. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Physikalisch-Technische Abt.). Jun 1971. 20p. (In German).

2393 (HEDL-TME-74-29) TEST REPORT OF THE EVALUATION OF FLOW DIVIDER BELLOWS FOR CLOSED LOOP IN-REACTOR ASSEMBLY. Gilmore, R. F. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jun 1974. Contract AT(45-1)-2170. 18p. AT.

The results of tests performed on the Closed Loop In-Reactor Assembly Flow Divider Tube Bellows are presented. Two test bellows were life tested in sodium environments to verify their ability to withstand CLIRA thermal cycles at normal system temperature and pressure operating conditions. The test environments did not affect the integrity of either bellows. It is recommended that the Flow Divider Tube Bellows be accepted for FFTF application. (auth)

2394 (HEDL-TME-74-40) SODIUM FIRE PROTECTION BY COVERED TRENCH: FFTF PROOF TEST F4. Hilliard,

R. K.; Muhlestein, L. D. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jul 1974. Contract AT(45-1)-2170. 57p. AT.

The effectiveness of a covered trench for extinguishing sodium fires was evaluated by performing a large scale proof test. The trench was a steel lined concrete mockup of a section of pipe trench located in the Fast Flux Test Facility (FFTF) secondary sodium pump cells. The trench had a steel cover with holes to permit rapid drainage of sodium into the trench. Approximately 100 gallons of sodium at 1120°F were spilled onto a horizontal floor adjacent to the trench in a cell containing an air atmosphere. Approximately 98% of the sodium drained rapidly into the trench and the fire was immediately extinguished. Nitrogen flooding prevented oxygen re-entry. Measurements of temperature, pressure and O_2, H_2 and H_2O concentration confirmed that the covered trench provided an effective control of the sodium fire. Only 1.3% of the sodium entering the trench was oxidized. The linear prevented a direct sodium-concrete reaction but a significant quantity of water was released from the concrete by heat transfer through the liner. 7 references. (auth)

2395 (HMI-B-150) THE COMMISSIONING OF THE RESEARCH REACTOR BER-II WITH MTR FUEL ELEMENTS. Buchholz, H.; Fischer, C. O.; Wasserroth, K. (Hahn-Meitner-Institut fuer Kernforschung Berlin G. m. b. H. (F. R. Germany)). May 1974. 40p. (In German). INIS.

16 figs.; 8 tabs.; 9 refs.

Following a brief description of the reactor, a report on the critical experiment is given. The construction of the operating core is described. The measurements carried out deal with the thermal neutron flux density distribution, the calibration of the power range channels as well as with the total form factor and the temperature distribution. (GE)

2396 (JAERI-M-5613) HEAT DEPOSITION IN A SINGLE TEST FUEL PIN IN THE NSRR. 4. Physics and Nuclear Analysis of the Nuclear Safety Research Reactor. Ise, T.; Nakahara, Y. (Japan Atomic Energy Research Inst., Tokyo). Mar 1974. 43p. (In Japanese). NTIS (US Sales Only).

Parametric studies performed to determine conditions producing maximum pulsed mode heat depositions in UO_2 test pins located in the central cavity of the NSRR are described. A single UO_2 pin in a test capsule filled with water was considered. The calculations led to the following conclusions: (1) The higher the enrichment of UO_2 and smaller the thickness of the pin, the higher the heat deposition per unit volume of the test pin. (2) The heat deposition estimated by using the THERMOS data differs to some extent from that by GATHER data. The heat deposit depends on a water sheath around the pin; the thickness which results in the maximum deposit is 5.3 cm independent of the enrichment of uranium and the size of the test pin. (3) The thinner the capsule wall, the higher the heat deposition; the heat deposition is increased by using Inconel instead of Stainless steel as a capsule material. (4) The heat deposition in a pin decreases as the core becomes larger. (auth)

2397 (ORNL-TM-4733) OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT, APRIL, MAY, AND JUNE OF 1974. Hurt, S. S. III; Lance, E. D. (Oak Ridge National Lab., Tenn. (USA)). Oct 1974. Contract W-7405-eng-26. 31p. Dep. NTIS $4.75

The ORR operated at an average power level of 29.7 MW for 75.1% of the time during April, May, and June of 1974. Eighteen fuel elements were declared spent (49.9% average burnup) during the quarter, while eight new elements were placed in service. Two-shim-rod elements were retired from service at an average burnup of 59.7%. The reactor was shut down on nine occasions, one of which was unscheduled. Three of the scheduled shutdowns terminated special low-power runs. End-of-cycle shutdowns accounted for 91.4% of the total downtime. The remaining downtime was used principally for refueling and experiment work. Maintenance activities, both mechanical and instrument, were essentially routine in nature. Special tests or measurements completed during the quarter included: (1) reactivity measurement of the Metals and Ceramics experiment in CP-E8 and (2) flux measurements in support of the HTGR program. (auth)

2398 TEMPERATURE DISTRIBUTION AND COOLANT FLOW RATE IN THE FUEL ASSEMBLIES OF THE BOR-60 REACTOR CORE. Gryazev, V. M., Kondrat'ev, V. I.; Krupkin, L. K.; Masny, V. F. (Forschungsinstitut fuer Kernreaktoren, Dimitrovgrad, Yugoslavia). Kernenergie; 17: No. 6, 164-170 (Jun 1974). (In German).

Studies on the temperature distribution and coolant flow rate in the fuel assemblies of the BOR-60 reactor core are reported for reactor operation at different powers. The inhomogeneity coefficients of temperature distribution over the core and the permissible reactor power for given load are determined. (auth)

2399 FAST NEUTRON STUDIES IN URANIUM ASSEMBLIES. Tasa, K. S. Commerce, TX; East Texas State University (1973). 49p. University Microfilms Order No. 74-5777.

Thesis (Ph. D.).

The fast neutrons in the total neutron flux in natural uranium assemblies were determined radiochemically by introducing zinc into pure uranium salt assemblies as target material for the formation of fast neutron reaction products. After the system reached radioactive equilibrium for the desired product, copper was separated and purified for the presence of ^{64}Cu, possibly arising from the reaction $^{64}Zn(n,p)^{64}Cu$. Identification and quantitative determinations were made by the use of a low-level beta counting system. The fast neutron flux was determined experimentally by activation analysis in three samples, and was found to be 0.029 ± 0.003, 0.020 ± 0.002, and 0.019 ± 0.003 n/min/gU. The fast neutron flux for these three samples was calculated from reactor theory and found to be 0.026, 0.017, and 0.017 n/min/gU, respectively. The study demonstrated that detectable amounts of fast neutron reaction products can be isolated and quantitatively identified from certain uranium assemblies. The fast neutron flux obtained from the experimental measurements is in excellent agreement with the flux calculated from reactor theory. The study provides the first direct measurement by activation of the fast neutron flux present in a natural uranium assembly. (Diss. Abstr. Int., B)

2400 FUEL-ELEMENT TESTING CHANNEL LOOP WITH NATURAL COOLANT CIRCULATION. Klochko, G. A.; Kurov, V. A.; Maksimenko, V. I.; Martynov, A. D.; Potolovskii, V. G.; Bul'kanov, M. G.; Selivanov, V. M. Sov. At. Energy (Engl. Transl.); 34: No. 1, 52-54(Jan 1973).

Translated from At. Energ. (USSR); 34: No. 1, 40-42(Jan 1973).

A description is given of a compact loop facility designed to facilitate research on several different types of fuel-elements at comparatively low costs. The channel, which is designed for natural circulation of coolant, has an external cylindrical body within which the fuel assembly, a compact shell-and-tube heat exchanger with floating twin-chamber head and lifting and lowering tubes for the thermocouple, is accommodated. The heat exchanger is located at the top of the channel. The heat transfer surface is formed by a bundle of straight tubes sized 6×1 mm. Coolant water flows inside the tubes in a U-shaped circuit, and the collecting and distributing headers for the coolant are built into the head of the channel. The rotary chambers are staggered in height. Baffles are placed on the shell side of the heat exchanger to bring about transverse flow of coolant from the natural circulation loop over the tubes. The fuel assembly is accommodated within the lifting tube (dimensions 63×3.5 mm). Steel foil screens are provided in order to diminish the influx of heat from the graphite stacking of the reactor over the length of the reactor, and in order to diminish recuperative heating of the coolant in the lowering branch. Supply of coolant water to the heat exchanger and withdrawal of coolant water, as well as filling of the natural circulation loop, are achieved through ball-on-cone nipple type pipe connections. (auth)

Propulsion and Package Reactors

2401 (AD-777453) STRUCTURAL FEATURES OF NUCLEAR-POWERED SHIPS. Volkov, N. N.; Kodatskii, S. B. 21 Jan 1974. Translated from pp 7; 43; 48-57; 99-124; 143-205; 223-232; 243-246 of Konstruktivnye Osobennosti Atomnykh Sudov, Leningrad, 1971. (NISC-TRANS-3501). 131p. NTIS $9.75.

Among the design characteristics of nuclear-powered ships should be the following: disposition of the reactor with the primary circuit in the container device; collision protection of the side in the region of the reactor compartment; and bottom protection of the reactor compartment in case of running aground. The main design characteristics of nuclear-powered ships are determined by the measures directed toward increasing the operational safety of these ships. (GRA)

2402 (AD-778427) HEAT TRANSFER AND CONTAINMENT PROCESS IN TWO PHASE CAVITY NUCLEAR REACTOR. Final Report, 22 November 1971-21 January 1973. Stickler, D. B.; Lakshmikantha, H.; Lewellen, W. S. (Massachusetts Inst. of Tech., Cambridge (USA)). Feb 1974. Contract F33615-72-C-1344. 157p. (ARL-74-0007). NTIS $5.00.

Experimental study of liquid containment and heat transfer rates in a gas driven confined vortex was performed with reference to desired operating conditions for a liquid core nuclear rocket. Simple methods of containment and transport processes are used to scale the data to a predicted performance capability of a nominal 20,000 pound thrust, 1200 second specific impulse system. Molten

fuel containment, as a two phase zone on the cylindrical cavity side walls, appears feasible at or above levels required for thermal neutron reactor criticality. Two potential problems are that the input gas flow distribution must be chosen to avoid freezing of the nuclear fuel at the cavity walls, and that the overshoot of the fuel temperature relative to the peak gas stagnation temperature may cause excessive fuel vapor loss. (auth)

2403 (AD-778939) PARAMETRIC STUDY OF THE COLLOID CORE REACTOR ROCKET ENGINE. Final Report, 15 November 1971–15 July 1973. Ravets, J. M.; Black, D. L.; Faulkner, J. E.; Kyslinger, J. A.; Tobin, J. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Feb 1974. Contract F33615-72-C-1197. 204p. (WANL-PR-007). NTIS $5.75.

A parametric study of the colloid core reactor rocket engine concept is presented. Included are investigations of the effect on reactor design and engine weight of such factors as cavity geometry, fuel bed thickness and fuel distribution, reflector thickness, hydrogen content in the reflector region, uranium loss rate, thrust level and cladding of the fuel particles, as well as the clustering of small cavities within a common reflector. In the studies, the reflector was assumed to be unfueled with the propellant cycle providing the energy needed to drive the turbine. Except when considered as the independent variable in specific portions of the parametric study, the thrust and specific impulse were assumed to have the values of 50,000 pounds (1300 MW cavity fission power) and 1100 seconds, respectively, and the fuel form was considered to be ($^{233}U + {}^{10}Zr)C$. (auth)

2404 (DEU-73-30) NUCLEAR POWERED MERCHANT SHIPS. Technical and Economic Prospects. Jaeger, W.; Breyer, W.; Schneider, E. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany); Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bensberg/Koeln (F. R. Germany); Bremer Vulkan Schiffbau und Maschinenfabrik A. G. (F. R. Germany)). 1973. 30p. (In German).

Economic and technical developments in maritime transport are discussed, and some reasons are given for the use of nuclear propulsion for merchant ships. The experience gained with nuclear ship reactors is illustrated by details of the operation of the N.S. Lenin, Savannah, Otto Hahn, and Mutsu. Additional topics discussed are technical aspects of nuclear ships, the safety of such ships, legal and economic aspects, and the establishment of time schedules up to the operation of nuclear powered merchant ships. (GE)

2405 (GKSS-74/E/14) ACCURACY PROBLEMS IN THE POINT KINETICS OF THE OTTO-HAHN REACTOR. Fiebig, R. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany)). 1974. 31p. (In German). (AED-CONF-74-006-008). INIS.

From experts meeting of the task groups thermodynamics and fluid dynamics and reactor physics of the KTG on requirements and present possibilities of predicting physics parameters of thermal and fast power reactors; Karlsruhe, F. R. Germany (29 Jan 1974).

20 figs.; 1 tab.; 6 refs. With abstract.

In the Otto Hahn reactor core more steam bubbles are present than in PWR type reactors. Besides the larger reactivity coefficients, there exists a negative pressure coefficient and the reactor remains stable without an automatic control system. Yet the existence of bubbles means that the prediction of the reactivity coefficients is more complicated. Therefore, an experimental measuring program and additional computer programs were established in order to get information about the obtainable prediction accuracy. (GE)

2406 (GKSS-74/E/23) DYNAMICS MEASUREMENTS DURING THE START-UP EXPERIMENTS OF THE OTTO-HAHN REACTOR WITH ITS SECOND CORE. David, B.; Kolb, M.; Robinson, E.; Schwieger, E. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m. b. H., Geesthacht-Tesperhude (F. R. Germany)). 1974. 15p. (In German). (AED-CONF-74-006-006). INIS.

From experts meeting of the task groups thermodynamics and fluid dynamics and reactor physics of the KTG on requirements and present possibilities of predicting physics parameters of thermal and fast power reactors; Karlsruhe, F. R. Germany (29 Jan 1974).

6 figs.; 2 tabs.; 7 refs. With abstract.

During the start-up experiments, measurements of self-regulating behaviour and isothermal temperature coefficient, as well as pseudostochastic experiments were carried out. The test conditions, which are influenced by the actual xenon poisoning, and the reactivity worths of the rods at power were studied in particular. (GE)

2407 (GKSS-74/E/24) FREON STUDIES FOR THE DETERMINATION OF THE STATIONARY CRITICAL HEAT FLUX ON A 36-ROD BUNDLE WITH PWR GEOMETRY. Fulfs, H.; von Minden, C. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany)). 1974. 74p. (In German). Dep. NTIS (US Sales Only) $6.75.

Within the framework of the thermohydraulic core design for the nuclear ship project, freon studies for the determination of the critical heat flux were made on a 36-rod bundle which consisted of two zones of 16 or 20 axially equally charged rods. The geometry corresponded to the original dimensions of a ship reactor, and the experimental parameters approximated the equivalent water values. The freon-12 experimental values are reported in tables and diagrams and converted to the equivalent water values with the known conversion factors of Stevens and Bouré. The critical heat flux was calculated with the DYNAMIT core design program with consideration of the W3 relation used for PWR. A comparison showed that the calculated and the converted values of the critical heat flux deviated from each other by 10% on an average, indicating that the results from the W3 relation can be regarded as conservative. (tr-auth)

2408 (N-74-16804) DEVELOPMENT OF A MERCURY ELECTROMAGNETIC CENTRIFUGAL PUMP FOR THE SNAP-8 REFRACTORY BOILER DEVELOPMENT PROGRAM. Final Report. Fuller, R. A.; Schnacke, A. W. (General Electric Co., Cincinnati, Ohio (USA)). Feb 1974. Contract NAS3-10610. 77p. (NASA-CR-2375). NTIS $4.00.

An electromagnetic pump, in which pressure is developed in mercury because of the interaction of the magnetic field and current which flows as a result of the voltage induced in the mercury contained in the pump duct, was developed for the SNAP-8 refractory boiler test facility. Pump performance results are presented for ten duct configurations and two stator sizes. The test results were used to design and fabricate a pump which met the SNAP-8 criteria of 530 psi developed pressure at 12,500 lb/hr. The pump operated continuously for over 13,000 hours without failure or performance degradation. Included are descriptions of the experimental equipment, measurement techniques, all experimental data, and an analysis of the electrical losses in the pump. (auth)

2409 (N-74-17391) COMPUTER STUDY OF EMERGENCY SHUTDOWNS OF a 60-KILOWATT REACTOR BRAYTON SPACE POWER SYSTEM. Tew, R. C.; Jefferies, K. S. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Feb 1974. 32p. (NASA-TM-X-2979; E-7651).

A digital computer study of emergency shutdowns was conducted. Malfunctions considered were (1) loss of reactor coolant flow, (2) loss of Brayton system gas flow, (3) turbine overspeed, and (4) a reactivity insertion error. Loss of reactor coolant flow was the most serious malfunction for the reactor. Methods for moderating the reactor transients due to this malfunction are considered. (auth)

2410 (N-74-18320) ELECTRICAL HEATING TESTS OF URANIUM DIOXIDE EXTERNAL FUEL CONFIGURATION AT EMITTER TEMPERATURE OF 1900 K. Dilanni, D. C.; Mayer, J. T. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Mar 1974. 30p. (NASA-TM-X-2994; E-7554). NTIS $3.25.

Testing of two fuel clad specimens for thermionic reactor application is described. The annular UO_2 fuel was clad on both sides with tungsten; heat rejection was radially inward. The tests were intended to study inner clad stability, fuel redistribution, and fuel melting problems. The specimens were tested in a vacuum chamber using electron bombardment heating. Fuel structural changes were studied using periodic gammagraphs and posttest metallography. The first specimen test was terminated at 50 hours because of a braze failure. The second specimen was tested for 240 hours when an outer clad leak developed due to a tungsten-water reaction. The fuel developed numerous cracks on cooldown but the inner clad remained dimensionally stable. The fuel cover gas did not impede the rate of fuel redistribution. Posttest examination showed the fuel had not melted during operation. (auth)

2411 (N-74-18321) OFF-DESIGN TEMPERATURE EFFECTS ON NUCLEAR FUEL PINS FOR AN ADVANCED SPACE-POWER-REACTOR CONCEPT. Bowles, K. J. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Mar 1974. 24p. (NASA-TM-X-2981; E-7606). NTIS $3.00.

An exploratory out-of-reactor investigation was made of the effects of short-time temperature excursions above the nominal operating temperature of 990°C on the compatibility of advanced nuclear space-power reactor fuel pin materials. This information is required for formulating a reliable reactor safety analysis and

designing an emergency core cooling system. Simulated uranium mononitride (UN) fuel pins, clad with tungsten-lined T-111 (Ta–8W–2Hf), showed no compatibility problems after heating for 8 hours at 2400°C. At 2520°C and above, reactions occurred in 1 hour or less. Under these conditions free uranium formed, redistributed, and attacked the cladding. (auth)

2412 (N-74-20238) DEVELOPMENT CONCEPT FOR A SMALL, SPLIT-CORE, HEAT-PIPE-COOLED NUCLEAR REACTOR. Lantz, E.; Breitwieser, R.; Niederauer, G. F. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Apr 1974. 35p. (NASA-TM-X-2996; E-7542). NTIS $3.25.

There have been two main deterrents to the development of semiportable nuclear reactors. One is the high development costs; the other is the inability to satisfy with assurance the questions of operational safety. Consideration of a split-core, heat-pipe cooled reactor indicates that these deterrents could conceptually be eliminated. Recent work on split-core, heat-pipe reactors is examined and summarized. A concept for a small reactor that could be developed at a comparatively low cost is presented. The concept would extend the technology of subcritical radioisotope thermoelectric generators using $^{238}PuO_2$ to the evolution of critical space power reactors using $^{239}PuO_2$. (auth)

2413 (N-74-20698) SNAP-8 REFRACTORY BOILER DEVELOPMENT PROGRAM. Final Report. Fuller, R. A. (General Electric Co., Cincinnati, Ohio (USA)). Apr 1974. 230p. (NASA-CR-2372). NTIS $6.00.

Performance and endurance tests of the SNAP-8, SN-1 refractory metal boiler are described. The tests were successful and indicated that the boiler heat transfer area could be reduced significantly primarily because of the wetting characteristics of mercury on tantalum in a contaminant-free environment. A continuous endurance test of more than 10,000 hours was conducted without noticeable change in the thermal performance of the boiler. A conclusion of the metallographic examination of the boiler following the endurance test was that expected boiler life would be of the order of 40,000 hours at observed corrosion rates. (auth)

2414 (NP–20205) AFTER-HEAT REMOVAL OF HIGH-TEMPERATURE REACTORS. Krontiris, E. (Technische Univ. Hannover (F. R. Germany). Fakultaet fuer Maschinenwesen). 21 Nov 1972. 105p. (In German). INIS.

49 figs.; 3 tabs.; 30 refs. With abstract. Available from the library of Technische Univ. Hannover.

Theoretical investigations have shown that the after-heat produced in a shut-down high-temperature reactor provides a sufficiently large energy source to operate an emergency cooling system with gas turbines and compressors in a closed circuit. The after-heat of such reactors can be removed to such an extent with the emergency cooling system developed here, that the danger of a nuclear accident occuring due to melting of the reactor core and release of fission products to the surroundings can be reduced to a minimum. The operating time of such an emergency cooling system according to the optimization of its design basis, can be of the order of 10^6 seconds, a time interval which appears sufficient in order to take measures to prevent nuclear dangers. The safety technical considerations refer to the HTR as land-based plant and the HTR as ship's plant. Within the framework of this study, a ship's plant with high-temperature reactor has been investigated. The cooling system with gas turbines developed from the safety philosophy of such a plant can also be used in plants on land. The emergency cooling system of these reactors is not merely a question of safety, but also an economical one. (GE)

2415 KERNENERGIE-HANDELSSCHIFFE. Technische und Wirtschaftliche Aussichten. (Nuclear Powered Merchant Ships. Technical and Economical Aspects). Geesthacht; GKSS (1973). 30p. (In German).

27 figs.; 4 tabs.

Following a consideration of the economical and technical developments in marine traffic, arguments for the nuclear ship propulsion are presented. The state of development and the experience with ship reactors as well as the technical aspects of nuclear powered ships are described. Furthermore, the safety of nuclear powered ships, legal questions and the economics of nuclear powered ships are dealt with. Finally, a time-schedule until the use of nuclear powered merchant ships is suggested. (GE)

2416 PROPULSION SYSTEMS FOR SPACE VEHICLES: THE CURRENT STATE OF THE ART. Lo, R. (Deutsche Foschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Lampoldshausen, Ger.). Interavia; 28: 1338-1342(Dec 1973).

Chemical propulsion systems have an exhaust velocity limited to about 5000 m/sec, since the energy density of the chemical propellant combinations sets a top limit to the temperature which can be achieved (about 4500°K). As regards thrust, these propellants have no upper limit of a physical nature. Nuclear propulsion systems are theoretically only limited in their specific thrust at very high velocities, but in practice lower limits are imposed by the nature of the materials involved. Electrical propulsion systems theoretically have no upper limit (apart from that of the speed of light) to their exhaust velocity. Their minimal thrust is dictated by their applications; of greater practical significance is their maximum thrust, which depends on the electrical energy available. Booster motors, course-correction and attitude control thrusters, and electrical motors are considered. (IAA)

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Refer also to abstracts 466, 525, 566, 716, 717, 719, 820, 821, 825–830, 837, 1087, 1102, 2227, and 2594.

2417 (AD-778713) CYCLIC TRIAXIAL COMPRESSION TESTS, WATTS BAR NUCLEAR POWER PLANT SITE, SOUTHEAST TENNESSEE. Final Report. Gilbert, P. A.; Collins, S. A. (Army Engineer Waterways Experiment Station, Vicksburg, Miss. (USA)). Apr 1974. 23p. NTIS $4.25.

The objective of this study was to furnish cyclic triaxial test results for use in a liquefaction potential analysis of silty sand in the Watts Bar Nuclear Power Plant cooling water intake channel earth-cut slope. The in situ foundation density was determined from undisturbed boring samples. Saturated consolidated-undrained cyclic triaxial tests were performed on the fine sand at the determined in situ density and at an effective confining pressure computed from in situ overburden weights. A series of tests was performed on specimens consolidated to isotropic stress conditions, and two other series of tests were performed on specimens consolidated to two anisotropic stress conditions. (GRA)

2418 (AED-CONF-73-161-001) EXPERIENCE WITH AND RESULTS OF RELIABILITY ANALYSES OF DIFFERENT REACTOR SAFETY SYSTEMS. Eggert, H. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Koeln (F. R. Germany)). 1973. 5p. (In German). (CONF-7305102-1).

From meeting on technical reliability; Nuremberg, F. R. Germany (23 May 1973).

The analytical methods applied at the IRS for comparing the failure behavior of complex protection and safety systems in nuclear power plants are briefly described. Calculus of variations for a scram system is discussed as an example. (GE)

2419 (AED-CONF-73-161-002) SAFETY ASPECTS, RELIABILITY, AND AVAILABILITY OF PROCESS COMPUTER SYSTEMS FOR THE PROTECTION OF NUCLEAR POWER PLANTS. Renk, K. D. (Technischer Ueberwachungs-Verein Norddeutschland e.V., Hamburg (F. R. Germany)). 1973. 6p. (In German). (CONF-7305102-2).

From meeting on technical reliability; Nuremberg, F. R. Germany (23 May 1973).

It is shown that for the extreme reliability requirements in nuclear engineering, special hardware and software methods have to be developed in order to allow the use of process computers. The concepts already put into practice and their reliability are described in detail, and development trends are shown. It can be expected that out of the variety of concepts and models currently discussed and tested in various countries, some clearly defined methods will emerge that will meet the requirements of reactor safety and reliable operation and will likely be put into practice in the near future. (GE)

2420 (AED-CONF-73-500-001) EVALUATION OF COMPUTER PROGRAMS AND THEIR VERIFICATION BY MEANS OF EXPERIMENTAL INVESTIGATIONS. Rohde, J. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Koeln (F. R. Germany)). 1973. 40p. (In German). (CONF-731151-1).

From 9th meeting on emergency core cooling systems in nuclear power plants; Cologne, F. R. Germany (8 Nov 1973).

Problems encountered in the evaluation of analysis techniques used by manufacturers are discussed. The most important problem is to ensure that the program technique and the calculational results include sufficient conservatism. After defining the concept of conservatism, as applied to safety considerations, the procedure presently used in reviewing analysis techniques is illustrated by means of examples. Results of sensitivity studies and fault tree analyses are briefly presented. For the purpose of clarity, the use of the fault tree technique is recom-

mended in uncertainty analyses. Problems concerning the transferability and applicability of test results are briefly dealt with. (auth)

2421 (AED-CONF-73-500-006) PROPOSALS FOR FURTHER IMPROVEMENT OF SAFETY CRITERIA. Eisele, H. (Technischer Ueberwachungs-Verein Baden e.V., Mannheim (F. R. Germany)). 1973. 25p. (In German). (CONF-731151-6).

From 9th meeting on emergency core cooling systems in nuclear power plants; Cologne, F. R. Germany (8 Nov 1973).

Safety criteria for ECCS of water-cooled power reactors are discussed. Assumptions of initial conditions for the analysis of LOCA and the present procedure in assessing redundancy of the ECCS are outlined. Proposals for regulations to limit the calculated transients of a LOCA are discussed. An appendix includes some general requirements for ECCS and other safety systems and remarks regarding special criteria. (auth)

2422 (AED-CONF-73-665-001) APPLICATION OF FRACTURE MECHANICS IN THE SAFETY ANALYSIS OF REACTOR COMPONENTS (BRITTLENESS FRACTURE, FRACTURE TOUGHNESS, CRACK GROWTH). Dorner, H.; Bartholome, G.; Schmitt, W.; Vasoukis, G. (Deutscher Verband fuer Materialpruefung e.V., Berlin (F. R. Germany)). 1973. 6p. (In German). INIS.

From fifth meeting of the Deutscher Verband fuer Materialpruefung: fracture processes; Karlsruhe, F. R. Germany (11 Oct 1973).

A description is given of methods of fracture mechanics which are used in safety evaluation of reactor components with regard to brittleness fracture and fracture toughness and the evaluation of crack growth caused by load changes. (INIS)

2423 (AED-CONF-74-002-007) TESTS FOR DEMONSTRATING THE SAFE FUNCTIONING OF HARDWARE AND SOFTWARE IN REACTOR PROTECTION COMPUTERS. Schueller, H.; Ehrenberger, W. 1974. 5p. (In Germany). INIS.

From 2nd information meeting of the Laboratorium fuer Reaktorregelung und Anlagensicherung Garching (LRA); Muenchen, F. R. Germany (16 Jan 1974).

An outline is given of the basic principles and models which allow programs to be tested statistically with regard to their performance within the reactor protection system, yielding information about the maximum error probability of a given program. (INIS)

2424 (AED-CONF-74-066-011) DEVELOPMENT OF METHODS FOR THE ANALYSIS OF HYPOTHETICAL ACCIDENTS. Froehlich, R. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). 1974. 13p. (In German). INIS.

From status report of the Projekt Schneller Brueter; Karlsruhe, F. R. Germany (26 Mar 1974).

7 figs.; 2 tabs. Available from ZAED.

The theoretical models and computer programs developed for the analysis of the different possible accident phases of the SNR are discussed. The accident course is divided into 4 possible phases: pre-disassembly; disassembly; mechanical stresses on the strucutres, and post-accident heat removal. (GE)

2425 (AI-AEC-Memo-12736) HNPF RETIREMENT DISPOSITION OF SODIUM. Boardman, T. J.; Paulett, T. A. (Atomics International Div., Canoga Park, Calif. (USA)). 30 Sep 1968. Contract AT(04-3)-701. 132p. Dep. NTIS $9.75.

The removal of all bulk sodium from the HNPF site and the chemical reaction of residual sodium in the system are described. A list of all activity specifications and operating procedures covering the tasks at each phase of the operation is provided. The plans, performance, and results of the procedures are described. (DG)

2426 (ANL-8099) INITIAL TREAT LOOP EXPERIMENTS ON LMFBR OXIDE FUEL BEHAVIOR DURING A POWER EXCURSION (TESTS E1 AND E2). Dickerman, C. E.; Robinson, L. E.; Agrawal, A. K.; Murphy, W. F.; Wright, A. E. (Argonne National Lab., Ill. (USA)). May 1974. Contract W-31-109-eng-38. 50p. AT.

Experimental and analytical results from the first two TREAT tests on the meltdown of fresh, 13%-enriched UO_2 under overpower conditions in the Mark-II flowing sodium loop are presented. In the first test about 80% of the cross section melted during the 420-cal/g-UO_2 power burst, but fuelpin failure was prevented, apparently by the easy axial movement of molten fuel and the relatively low sodium temperature. The maximum measured plastic strain in the stainless steel cladding was 1.14%, occurring at the fuel midplane. In the second test, a 640-cal/g-UO_2 power burst caused extensive cladding failure when about 90% of the fuel cross section was calculated to have melted. The appearance of the cladding remains was consistent with failure by meltthrough. Fuel was extremely fragmented and dispersed, with packed fines nearly completely blocking the flow channels. Maximum cladding strain was measured to be 1.5%. Conversion of fuel energy to work done on the coolant was very small ($\sim 6 \times 10^{-4}$). (auth)

2427 (ANL-8101) NONLINEAR DYNAMIC ANALYSIS OF REACTOR HEAD COVERS (FAST-REACTOR CONTAINMENT PROGRAM). Schoeberle, D. F.; Chang, Y. W.; Gvildys, J.; Bratis, J. C. (Argonne National Lab., Ill. (USA)). May 1974. Contract W-31-109-eng-38. 53p. AT.

A numerical method for calculating the two-dimensional response of the primary reactor head cover during a high-energy excursion is described. The head cover is modeled as a thick circular plate with a ring of holddown bolts around the outer edge. The pressure loading on this plate is generated by the Lagrangian computer program REXCO-HEP such that an accurate description of the time-dependent and spatially varying pressure is available. A dynamic elastic–plastic finite-element program was written to analyze the stresses and displacements in the cover plate simultaneously with the coupled (finite-difference) analysis of the coolant-slug impact. The two programs are fully coupled: a REXCO subroutine furnishes the pressure variation and the bolt holddown force to the finite-element program subroutine DRIVER, which on return furnishes axial displacements for the contacting coolant slug. This method is intended to form part of a dynamic analysis and design method for the reactor head cover. (auth)

2428 (ANL-8130) RECENT ADDITIONS TO THE PARAMETRIC MODEL OF FUEL-COOLANT INTERACTIONS. Chen, W. L.; Cho, D. H.; Kazimi, M. S. (Argonne National Lab., Ill. (USA)). Sep 1974. Contract W-31-109-Eng-38. 32p. AT.

Recent additions to the parametric model of fuel-coolant interactions are summarized. They include effect of gas-vapor blanketing, effect of elastic wall deformation, effect of distribution of fuel-particle size, and three types of constraint. In addition, the current computer program of the parametric model is briefly described. 4 references. (auth)

2429 (CENPD-134(Rev.01)) COMPERC-II, A PROGRAM FOR EMERGENCY REFILL-REFLOOD OF THE CORE. (Combustion Engineering, Inc., Windsor, Conn. (USA)). Aug 1974. 171p.

The COMPERC-II computer code was written at CE to analyze the core refill and reflood transient portion of a PWR loss of coolant accident (LOCA). The COMPERC-II code handles the refill-reflood transient, except for the calculation of peak cladding temperatures. The refill transient starts at the time the safety injection water starts to enter the downcomer and falls into the lower plenum. Since the safety injection water is injected directly into the lower plenum by the code, the time to start safety injection is delayed to account for the time delay of the water falling down the annulus. (auth)

2430 (CONF-740401-P1) PROCEEDINGS OF THE FAST REACTOR SAFETY MEETING, BEVERLY HILLS, CALIFORNIA, APRIL 2–4, 1974. (American Nuclear Society, Los Angeles, Calif.). 1974. 542p. Dep. NTIS $13.60.

Information on fast reactors is presented concerning safety related criteria and design features for next-round LMFBR's, steam generators, TREAT fuel behavior experiments, fast reactor safety research needs, sodium fires, aerosols, and plutonium. Separate abstracts are included for 27 of the 32 papers presented. Five of the papers have previously been abstracted and included in NSA under the following abstract numbers: 30:01928, 30:01982, 30:01929, 30:01930, and 30:07140. (DCC)

For abstracts of individual papers see: 820, 2350–2358, 2390, and 2431–2446.

2431 (CONF-740401-P1, pp 95-108) INTERACTION OF STEAM GENERATOR MODULES DURING A SODIUM–WATER REACTION. Stuteville, D. W. (Combustion Engineering, Inc., Windsor, CT). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

Considerable design effort must be expended to assure that the steam generating system of a Liquid Metal Fast Breeder Reactor (LMFBR) contributes to a high plant availability factor. Steam generator tubes must operate under extremes of pressure and temperature, especially during transients. Combustion Engineering, Inc.'s modular steam generating system is described. Results of the analysis of the secondary heat transport system for a sodium-water reaction are presented, and recommendations for minimizing recovery following a sodium-water reaction are given. 5 references. (auth)

2432 (CONF-740401-P1, pp 109-123) PRESSURE-WAVE PROPAGATION TESTS IN THE SECONDARY LOOP OF FBR. Hishida, M.; Sato, K.; Hori, M. (Power Reactor and Nuclear Fuel Development Corp., Tokyo). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The pressure-wave propagation tests in the simulated secondary loop of sodium cooled fast reactor MONJU were conducted. Water was utilized for the propagation media instead of sodium. Experimental results were compared with the calculated results by computer codes SWAC-5K and SWAC-5H. A good agreement between the calculated and the experimental results was obtained, except near and in the IHX model. It was found that it is possible to analyse the pressure-wave propagation in the secondary loop by one-dimensional method. 8 references. (auth)

2433 (CONF-740401-P1, pp 124-135) TRANSWRAP: CODE FOR ANALYZING THE SYSTEM EFFECTS OF LARGE-LEAK SODIUM–WATER REACTIONS IN LMFBR STEAM GENERATORS. Bell, C. R. (Atomics International Div., Canoga Park, CA). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

TRANSWRAP, TRANsient Sodium Water Reaction Analysis Program, is an overall system analysis of the effects of large tube leaks in an LMFBR steam generator and the associated sodium-water reaction. The general capabilities of the code are presented as well as the underlying assumptions and fundamental bases. The application of the code to a large LMFBR secondary heat transfer loop is discussed and selected calculated results are given. 4 references. (auth)

2434 (CONF-740401-P1, pp 239-253) FUEL DYNAMICS EXPERIMENTS SUPPORTING FTR LOSS-OF-FLOW ANALYSIS. Deitrich, L. W.; Barts, E. W.; De Volpi, A.; Dickerman, C. E.; Eberhart, J. G.; Carter, J. C.; Fischer, A. K.; Murphy, W. F.; Stanford, G. S. (Argonne National Lab., IL). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

Three experiments conducted by the Fuel Dynamics program at Argonne National Laboratory in support of analyses of the hypothetical unprotected-loss-of-flow accident are reviewed. The tests designated L2, L3, and L4 were intended to provide experimental data against which predictions of the accident analysis codes can be compared and to guide further analysis and modeling of the initiating phases of the hypothetical accident. Before these tests, there were few data directly applicable to the loss-of-flow accident in an LMFBR and no results from integral experiments to support the analytically-derived scenario. The goal of obtaining integral data allowing comparison of the gross features of the response of fresh and irradiated fuel elements to loss of flow has been realized. 6 references. (auth)

2435 (CONF-740401-P1, pp 254-267) SUMMARY OF AUTOCLAVE TREAT TESTS ON MOLTEN-FUEL–COOLANT INTERACTIONS. Wright, R. W.; Barghusen, J. J.; Zivi, S. M.; Epstein, M.; Ivins, R. O.; Mouring, R. W. (Argonne National Lab., IL). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

Eight transient meltdown tests on the interaction of molten LMFBR fuel and coolant have been performed in the TREAT reactor using a stagnant-sodium filled autoclave that contains an inertial loading piston. These S-series tests were essentially scoping experiments to investigate the transient pressure generated and the mechanical work done by the meltdown of clad fuel pins in sodium under conditions of very energetic overpower transients and of prompt-burst disassembly of a nearly unvoided LMFBR core. Three of the tests used an open rectangular array of five fueled and four dummy pins (S-3 to S-5), three used a wire-wrapped close-packed hexagonal seven-pin array (S-6 to S-8), and two used a single test fuel pin (S-11 and S-12). All the tests except S-7 and S-8 were performed from initial temperatures in the range from 150–210°C. Tests S-7 and S-8 used initial temperatures of about 500°C so that sodium boiling would occur before fuel failure. The period of the self-limited TREAT reactor power excursions used in these tests varied over the range from 23–53 msec, so the full-widths at half maximum of the fission-heating bursts varied from 103–240 msec. 9 references. (auth)

2436 (CONF-740401-P1, pp 268-278) FUEL VAPORIZATION AND QUENCHING BY COLD SODIUM: INTERPRETATION OF TREAT TEST S-11. Epstein, M.; Cho, D. H. (Argonne National Lab., IL). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

An analysis has been made of the pressure-time history following fuel failure in TREAT Test S-11. The S-11 autoclave pressure trace is postulated to depend on the relative rates of fission heating of the UO_2 fuel and heat loss from the fuel to the surrounding cold sodium and autoclave structure. Reasonable agreement is obtained between the experimental pressure trace and the pressure trace predicted by the analysis. This agreement depends on only one parameter characteristic of the interfacial area for heat transfer separating UO_2 fuel vapor and cold sodium. Based on this agreement, it appears that sodium vaporization contributed very little to the observed autoclave pressure, and therefore, that the sodium and cold structure acted only to quench the hot fuel. 14 references. (auth)

2437 (CONF-740401-P1, pp 279-302) R-SERIES LOSS-OF-FLOW SAFETY EXPERIMENT IN TREAT. Grolmes, M. A.; Holtz, R. E.; Spencer, B. W.; Miller, C. E.; Kramer, N. A. (Argonne National Lab., IL). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

One single-pin and two seven-pin loss-of-flow simulation experiments have been carried out in support of LMFBR safety analysis. These TREAT in-pile tests were executed in the new R-series test apparatus. This test apparatus provided improved thermal hydraulic simulation by using full-length test fuel pins of typical FTR dimensions. Test results proved to be consistent with pretest analysis of anticipated sodium boiling, clad and fuel motion characteristics. Some differences, however, associated with early voiding flow regime and simultaneous gas release are observed and discussed. Upon melting, cladding material appeared to flood the test section and then drain, causing a substantial inlet blockage. At steady power, the fuel melted and subsequently collapsed. The overall sequence of the test events is consistent with predictions from accident analysis models. 17 references. (auth)

2438 (CONF-740401-P1, pp 305-342) FRENCH PROGRAM ON LMFBR SAFETY. Robeaux, M.; Tattegrain, A. 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The description of the safety studies on fast reactors suggested under four questions: "What? Why? How? When?" is given from the point of view of the main incentives. Answers to the four questions are respectively deduced from a method of safety assessment based on the availability of various barriers existing between the public and dangerous products, from the survey of the fast reactor specific safety characteristics, from a logical course for defining the studies required under the preceding considerations, and lastly from a compromise as consistent as possible between the implementation of the necessary study equipment and the schedule of fast reactor development in France. The main results and the knowledge gained on the evaluation of the safety of the barriers with regard to the points mentioned above are given. Research work includes: out-of-pile studies on sodium boiling; out-of-pile studies on sodium-melted fuel interaction; in-pile studies of fuel failures (SCARABEE and CABRI programs); behavior of the primary containment under accidental conditions; and sodium fires and aerosols. 15 references. (auth)

2439 (CONF-740401-P1, pp 343-360) FAST REACTOR SAFETY RESEARCH NEEDS: WHAT, WHY, HOW, AND WHEN? Teague, H. J. (United Kingdom Atomic Energy Authority, Culcheth, Eng.). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

2440 (CONF-740401-P1, pp 361-378) FAST REACTOR SAFETY RESEARCH NEEDS WITHIN THE DEBENELUX-PROJECT SNR. Kessler, G. (Kernforschungszentrum, Karlsruhe, Ger.). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The status of the present safety R&D-program carried out within the SNR-300 project is described. The main activities are concentrated on two problem areas: DBA analysis with related code development and supporting experimental programs; and local coolant blockages within a subassembly and related experimental programs as well as instrumentation development. The status of knowledge for different safety problems is reviewed. The research needs and the necessary extensions of current programs are then discussed with regard to safety problems of future large fast breeders. 59 references. (auth)

2441 (CONF-740401-P1, pp 379-384) FAST REACTOR SAFETY RESEARCH NEEDS: WHAT, WHY, HOW, AND WHEN? Avery, R. (Argonne National Lab., IL). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

2442 (CONF-740401-P1, pp 385-401) LMFBR SAFETY RESEARCH AND DEVELOPMENT AT PNC. Kawaguchi, O. (Power Reactor and Nuclear Fuel Development Corp., Tokyo). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

PNC's research and development programs are reviewed for the two Japanese LMFBR's: the experimental JOYO and the prototype MONJU. Some details are given in the areas of reactor core safety, structural safety, accident cooling, safety instrumentation and radioactivity safeguards. (auth)

2443 (CONF-740401-P1, pp 402-410) LMFBR SAFETY RESEARCH: A VIEW FROM OUTSIDE. Cochran, T. B. (Natural Resources Defense Council, Washington, DC). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

2444 (CONF-740401-P1, pp 417-430) BEHAVIOR OF SODIUM AREA CONFLAGRATIONS AND SUITABLE PROTECTING SYSTEMS. Huber, F.; Menzenhauer, P.; Peppler, W.; Till, W. (Kernforschungszentrum, Karlsruhe, Ger.). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

Within the scope of the fast breeder reactor (SNR) safety R and D program the course of fires with amounts of sodium up to 200 kg has been investigated. The studies were directed to sodium area conflagrations and their confinement and avoidance, respectively, by preventive engineering measures. Moreover, the course of the fire was studied for different types of sodium discharges from an uncovered leak and with leakages from insulated pipe sections. The tests were performed in an enclosure. The aerosols generated in the fires were removed via an exhaust air system. 14 references. (auth)

2445 (CONF-740401-P1, pp 446-460) AEROSOL RESEARCH AT RCN. van de Vate, J. F. (Reactor Centrum Nederland, Petten). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

An experimental and theoretical study on enclosed aerosols has been carried out in order to refine the safety evaluation of hypothetical severe reactor accidents taking into account the natural instability of aerosols under post-accident conditions. Special attention was given to the fact that gravity causes decay heat producing material to collect in the lower part of the inner containment. Under these conditions settling is hampered, which process is the usual base for calculation of aerosol concentration after the accident. Thermophoretic deposition coupled with the decay heat flux is proved to be a process which is very useful for these calculations. First results concerning the effect of coolant evaporation and condensation on aerosol stability are presented. Aerosols in unheated containments were investigated by means of the Stöber spiral centrifuge. This revealed that after ageing of enclosed aerosols their aerodynamic diameter distribution is very narrow. Effects of specific formation energy, aerosol material mixed with a second component, are also dealt with. Experiments using model aerosols show the relative effects of settling and diffusion. 32 references. (auth)

2446 (CONF-740401-P1, pp 488-497) ONE-CELL AND TWO-CELL SODIUM POOL FIRE TESTS. Baurmash, L.; Nelson, C.; Johnson, R.; Koontz, R.; Morewitz, H. (Atomics International Div., Canoga Park, CA). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

A series of one-cell and two-cell sodium pool fire tests have been conducted to investigate the LMFBR cell pressurization following a sodium spill. The one-cell tests were performed in a closed 2200-ft^3 vessel, which is about a $1/10$ scale representation of an LMFBR primary vault. The data from one-cell pool fire compared favorably with the predictions given by a computer model (SOFIRE-II), provided that the correct ratio of combustion products was assumed. (The assumption that only sodium monoxide was produced always gave higher vault pressures than those observed.) In order to study those situations in which the primary heat transport equipment cells communicate with the secondary containment, either via one or two openings, a series of two-cell tests were performed. These two-cell tests were performed at $1/100$ scale, with either a single restricted opening between cells or with two cells connected by two openings. The results of the tests were also compared to SOFIRE-II predictions. The mass transfer model used in analyzing the single-opening tests appear to be adequate, since the computed oxygen content vs time in the secondary agrees well with the experimental data, and the heat transfer model used for the primary cell appears to represent the dynamics of the system adequately. The two-opening, two-cell test produced higher pressures and temperatures than the one-opening test. Extrapolation of the data from both tests to a full-scale LMFBR plant showed that the pressure rises (<10 psi) were easily within the capability of the LMFBR containment. Thus, changing the hole configuration does not affect the containment building design pressure. (auth)

2447 (CONF-740401-P2) PROCEEDINGS OF THE FAST REACTOR SAFETY MEETING, BEVERLY HILLS, CALIFORNIA, APRIL 2–4, 1974. (American Nuclear Society, Los Angeles, Calif.). 1974. 597p. Dep. NTIS $13.60.

Separate abstracts were prepared for 28 of the 33 papers included. The remaining 5 papers have previously appeared in NSA. (JMR)

For abstracts of individual papers see: 466, 2359, and 2448–2473.

2448 (CONF-740401-P2, pp 535-549) OUT-OF-PILE SIMULATION OF FUEL PIN BEHAVIOR IN SODIUM COOLED FAST BREEDER REACTORS BY UO_2 RODS HEATED BY ELECTRICAL CURRENT. Alexas, A.; Lindner, W.; Schikarski, W. (Kernforschungszentrum, Karlsruhe, Ger.). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

Experiments carried out in the Experimental Pin Burst Facility on LMFBR-type fuel pins are reported. Electric heating was used to simulate overpower transients in UO_2 fuel pins. Some conclusions on fuel pin behavior and failure mechanisms are discussed. (JWR)

2449 (CONF-740401-P2, pp 550-564) BEHAVIOR OF FAST REACTOR FUEL PINS UNDER LOSS OF COOLANT FLOW CONDITIONS. Kwast, H. (Reactor Centrum Nederland, Petten). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The experimental programme on Fast Reactor Safety, in progress at RCN, includes irradiations of single fuel pins under loss of coolant flow conditions. Two types of experiments are performed: (1) Clad failure experiments, designated as SHOT and (2) Loss of cooling experiments, designated as LOC. The capsules of all experiments performed so far were equipped with fresh fuel pins. Some of these were pre-pressurized. The fuel pins consist of 8% enriched UO_2 pellets of 5.1 mm diameter, clad in 5.24 mm inner diameter austenitic stainless steel tubing, with a wall thickness of 0.38 mm. In parallel with the SHOT experiments isothermal out of pile burst tests have been carried out at 950, 1000, 1050°C. From both the in pile (SHOT) and out of pile experiments, performed at about 1000°C, it has been observed that violent rupture of the canning occurred at internal fuel pin pressures of over 45 bar. The post-irradiation examination on some pre-pressurized LOC and SHOT fuel pins showed considerable clad melting. This is most likely caused by violent clad rupture which resulted in partial gas blanketing of the fuel pin. From the LOC experiments it has been concluded that violent fuel-sodium interactions did not occur at the time molten fuel entered the sodium annulus nor at the moment liquid sodium re-entered this annulus. (auth)

2450 (CONF-740401-P2, pp 598-614) SUBASSEMBLY-TO-SUBASSEMBLY FAILURE PROPAGATION: THERMAL LOADING OF ADJACENT SUBASSEMBLY. Marr, W. W.; Wang, P. Y.; Misra, B.; Padilla, A.; Crawford, R. M. (Argonne National Lab., IL). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

Some analytical results on subassembly failure propagation are presented, with emphasis on the effects of thermal loading on adjacent subassembly duct wall and coolant temperatures. Scoping analyses concerning melthrough and thermal stresses in the duct wall were made. It was found that the maximum expected heat fluxes due to molten fuel deposited on the subassembly wall did

not result in melthrough of the wall and that an irradiated duct might have a higher resistance against thermal loading than an unirradiated duct. Effects of external heat fluxes on coolant temperatures were investigated for normal and partially-crushed subassembly geometries. For a crushed subassembly, two cases were considered: the crushing of all six walls and the crushing of only one wall of the subassembly. Analyses were also performed to predict any temperature gradient within the deformed coolant subchannels adjacent to a heated wall. The results of these analyses indicated that local coolant boiling for normal operating conditions is not expected to occur even for values of the external heat flux as high as 2×10^6 Btu/hr-ft^2. (auth)

2451 (CONF-740401-P2, pp 615-640) EVALUATION OF PIN-TO-PIN FAILURE PROPAGATION IN LMFBR FUEL SUBASSEMBLIES. van Erp, J. B.; Chawla, T. C.; Fauske, H. K. (Argonne National Lab., IL). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

A survey is presented concerning experimental and analytical work performed with the aim of evaluating the potential for pin-to-pin failure propagation within fuel subassemblies of liquid metal cooled fast breeder reactors (LMFBR's) of current design (mixed U–Pu oxide pellets, stainless steel cladding). It is concluded that (1) the occurrence of pin-to-pin fuel failure propagation for current LMFBR fuel designs is improbable for any of the postulated propagation mechanisms, and (2) if failure propagation were to occur at all, then either it will be self-limiting or its progression will be slow, allowing ample time for detection (e.g., by means of monitoring systems for fission products in cover gas and reactor coolant), and for corrective action, if necessary. (auth)

2452 (CONF-740401-P2, pp 664-676) FUEL PIN BOWING UNDER LMFBR CONDITIONS. van der Putten, A. P. W. M.; van den Bogaard, J. P. A.; Boswinkel, H. H.; Heil, J. A.; Vonka, V. (Reactor Centrum Nederland, Petten). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The results and conclusions of a theoretical and experimental investigation on rod bowing, under liquid metal fast breeder reactor conditions, in 4, 7 and 12 rod electrically heated mockups of fuel elements is reported. Severe rod bowing was observed, upon visual and radio-neutrographic inspection after operation of above-mentioned clusters, caused by radial temperature gradients. This kind of bowing was of a progressive nature, as the bowing causes a changing subchannel geometry and thereby a change of the initiating temperature gradients. To investigate the bowing phenomena quantitatively the code BOBL was developed to study the combined influence of mass flow, temperature and rod bending. The description of these processes as used in the BOBL code predicts the experimental RCN bundle data reasonably well. From this it can be concluded that the further extension of the BOBL code will predict valuable results for LMFBR studies. In the BOBL code the effect of local blockages is also included. From blockage calculations it is concluded that local blockage situations cannot be correctly predicted without taking into account the bowing phenomena. (auth)

2453 (CONF-740401-P2, pp 701-715) NONSYMMETRIC TRANSIENT PRESSURE LOAD ON REACTOR VESSEL CAUSED BY POINT SOURCES SIMULATING FUEL–SODIUM INTERACTION. Krieg, R. (Kernforschungszentrum, Karlsruhe, Ger.). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The problem dealt with here, although applicable to other fields, is of importance for studies of Fast Reactor Safety, where the fuel-sodium interaction may greatly influence the evaluation of structural integrity of both the core and containment. Assuming small variations in fluid velocities, the field equations describing the transient flow problem can be linearized and the viscosity term is negligible. Under these simplifications, using the method of singularities, an exact solution is given satisfying boundary conditions which, in many cases, approximate the real boundary conditions very well. For a fluid bounded by a rotationally symmetric vessel, a computer code C0D1 has been developed. Three examples with asymmetrically located sources are examined. The results are summarized by graphs which show, among other things, the asymmetric fluid pressure distribution which may affect vessel design. (auth)

2454 (CONF-740401-P2, pp 716-731) STUDY OF NUCLEAR ACCIDENTS BY CHEMICAL SIMULATION EXPERIMENTS. Egleme, M. (Belgonucleaire, Brussels); Stievenart, M.; Holtbecker, H. 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The experimental and theoretical program carried out by BELGONUCLEAIRE in close cooperation with the Ispra Research Centre and INTERATOM and aiming at the simulation of the SNR hypothetical core disruptive accident in a vessel model is described. This program includes six phases: (1) The definition of the accident to be simulated and the choice of the scaling factor and of the explosive powder; (2) A series of explosion tests in an old flooded quarry to determine the powder characteristics; (3) A series of explosion tests in three types of $1/_{12}$ scaled down and simplified vessels; (4) A series of explosion tests in a $1/_8$ scaled down vessel; (5) A series of dynamic tests on materials; and (6) A final explosion test in a $1/_8$ SNR vessel model. Up to now all the experiments included in the five first phases have been completed, but not yet fully analyzed. The final explosion test is expected in June 1974. (auth)

2455 (CONF-740401-P2, pp 732-747) SIMULATED VAPOR EXPLOSION EXPERIMENTS AND DYNAMIC ELASTOPLASTIC RESPONSE OF SNR CORE. Gast, K. (Kernforschungszentrum, Karlsruhe, Ger.); Liebe, R.; Will, H.; Zehlein, H.; Rees, N. J. M.; Warren, G. R. 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

Fast reactor safety also requires to consider the core deformation problem eventually arising from local cooling disturbances or fuel failures. A program is described which combines theoretical as well as experimental studies of the transient, nonlinear structural behavior, simulated vapor explosion tests on full size SNR Core models and large scale fuel-coolant interaction experiments with UO_2 interacting with sodium. (auth)

2456 (CONF-740401-P2, pp 748-762) DEFORMATIONS IN A 19-PIN BUNDLE DUE TO A SUDDEN FLUID EXPANSION. Krieg, R.; Crawford, R. M. (Argonne National Lab., IL). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The transient flow and pressure fields as well as the pin deformations are determined for a flexible two-row pin bundle surrounded by an infinite fluid with a transient fluid source in the bundle center. By neglecting the fluid compressibility and viscosity, the solution for the flow problem is obtained by superposition of solutions for certain singularities (sources, dipoles, quadrupoles). The flexibility of the pins is essentially approximated by elastic pin bending and ovalization. Application is made to investigate the pin-bundle deformations due to a fuel-coolant interaction caused by a failed pin in a liquid-metal-cooled reactor. The results may help to estimate the potential for failure propagation. (auth)

2457 (CONF-740401-P2, pp 763-782) FAST REACTOR CONTAINMENT ANALYSIS, RECENT IMPROVEMENTS, APPLICATIONS, AND FUTURE DEVELOPMENT. Fistedis, S. H.; Chang, Y. W.; Marciniak, T. J.; Nagumo, G.; Gvildys, J. (Argonne National Lab., IL). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The problems involved in the evaluation of the response of LMFBR containment systems to Hypothetical Core Disruptive Accidents are described. Codes currently in use for such evaluations are discussed and planned improvements are summarized. (JWR)

2458 (CONF-740401-P2, pp 785-801) DECAY HEAT REMOVAL IN AN LMFBR. Zaleski, C. P.; Cravero, M.; Procaccia, H.; Antonakas, D.; Justin, F.; del Fabro, M.; Malaval, M.; Chalot, A. 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

Criteria pertinent to decay heat removal presently under consideration for LMFBR's in France are discussed. The solutions retained in the Super Phenix Project now in the detailed design phase, and in the Phenix Demonstration Plant now in operation are described. Some thoughts about extreme case of decay heat removal after an eventual core melt down accident are presented. An attempt at evaluating different decay heat removal systems by probabilistic methods is shown. The merits of this latter study is to provide a comparison of different solutions, and to detect eventual weak points, and/or reliability inhomogeneity of various sections of the system for a given solution. (auth)

2459 (CONF-740401-P2, pp 802-822) THERMAL CONTAINMENT OF REACTOR CORE MATERIAL AFTER SHUTDOWN. Peckover, R. S. (Culham Lab., Abingdon, Eng.). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

A temperature excursion arising through some hypothetical blockage of the cooling system in a liquid cooled reactor system could lead to the melt-out of the core or part of the core. One way of containing the core debris may be to allow it to fall into suitably designed core catchers placed below the core subassemblies. An alternative approach would be to allow the core material to settle on the bottom of the reactor pot which is cooled from below by forced convection. A third possibility is to allow the core to fall into a subterranean cavity built especially for the purpose. Any calculations of the heat fluxes depend on the transport processes involved. Often only thermal conduction is assumed and a number of detailed calculations have been made on this basis. Thermal convection within the heat-producing core debris modifies the heat transfer coefficients from the debris and the maximum temperatures within it. An indication is given of the extent to which more detailed calculation of internally heated thermal convection may alter current thinking on reactor safety. (auth)

2460 (CONF-740401-P2, pp 823-844) STUDIES AND EXPERIMENTS ON HEAT REMOVAL FROM FUEL DEBRIS IN SODIUM. Gabor, J. D.; Sowa, E. S.; Baker, L. Jr.; Cassulo, J. C. (Argonne National Lab., IL). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

Debris-bed heat transfer and self-leveling experiments were carried out to provide information needed for postaccident heat removal analysis of sodium-cooled reactors. The experiments were with particulate UO_2 in water, with particulate UO_2 in sodium, and with particulate UO_2 and stainless steel in sodium. Two types of experiments were performed: (1) bottom-heating from flame sources and (2) electrical heating within the coolant phase of the beds. The water tests with transparent apparatus enabled observations of the spontaneous leveling of the beds and the formation of channels which facilitated the escape of vapor. In deep beds, the channels did not reach the bottom, which accounted for the observed sharp decrease of dryout heat flux with increase in bed loading. The sodium tests showed the same general dependence of dryout heat flux on bed loading as the water tests. The volume-heated sodium tests provided data which are believed to be directly applicable to reactor-accident situations. Results with added stainless steel particulate were consistent with an assumption that the steel behaved similarly to the UO_2. On this basis, steel particulate underneath the fuel causes no reduction of heat-removal capability, whereas mixed beds have a decreased capability; beds with steel on top of the UO_2 have the lowest capability. (auth)

2461 (CONF-740401-P2, pp 845-864) BOILING HEAT TRANSFER FROM MOLTEN. Suo-Anttila, A. J.; Catton, I.; Erdmann, R. C. (Univ. of California, Los Angeles). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

Experimental results are used to establish the maximum temperature in the molten layer. Available molten UO_2 properties have been obtained and upper and lower bounds on the maximum temperature are obtained as a function of the molten fuel layer and the magnitude of the decay heat. Results are presented in terms of the required decay heat to initiate boiling as a function of layer depth. A model of the boiling molten fuel layer is developed which includes bubble nucleation, growth and bubble induced fluid circulations. The model is correlated with existing data for joule heated salt water and found to be reasonable over a wide range of heating rates. (auth)

2462 (CONF-740401-P2, pp 883-896) LARGE-SCALE MOLTEN FUEL–SODIUM INTERACTION EXPERIMENTS. Johnson, T. R.; Baker, L. Jr.; Pavlik, J. R. (Argonne National Lab., IL). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

Kilogram-scale, molten-UO_2-sodium interactions were performed in an unrestrained geometry to study the resulting energetics and fragmentation. The molten UO_2 was produced by the exothermic reaction between uranium and MoO_3 powders. Under the conditions of the experiments completed to date, the short-rise-time pressure pulses created in the liquid phase had negligible work potential and their magnitude did not increase with the amount of molten fuel. No significant gas-phase shock pressures were generated. The largest potential for mechanical work was the sodium vapor generated over a period of roughly one second. About 20% of the heat was effective in generating vapor. The experimental results show the marked tendency of molten UO_2 to form particulate after passage through only a few inches of sodium. Particle size distributions obtained under the conditions of the experiments were not significantly different from those obtained in prior small-scale tests and in TREAT tests. Also, the results indicate that the metallic component of the molten mixture formed larger particles than the oxide component. (auth)

2463 (CONF-740401-P2, pp 897-909) INITIATION MECHANISM OF THE EXPLOSIVE INTERACTION OF MOLTEN REACTOR FUEL WITH COOLANT. Zyszkowski, W. (Inst. of Nuclear Research, Warsaw). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The explanation of the thermal explosion is given which bases on the experimental observation of "jets" from molten "hot material" into the surrounding "cold liquid". Fast local changes of the thermal stress field during solidification are cause of the "hot material" fragmentation. Coupling of the fragmentation process with vapor explosion produces the full thermal explosion. (auth)

2464 (CONF-740401-P2, pp 910-921) OUT-OF-PILE STUDIES IN FRANCE ON SODIUM FUEL INTERACTION. Amblard, M.; Costa, J.; Fabrega, S.; Lackme, C.; Syrmalenios, P. (CEN, Grenoble, France). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The effort being made at the C. E. N. G. on out-of-pile studies on sodium-fuel interaction is described. Details are given for: the high performance devices developed to melt UO_2 and used to realize interactions with sodium; a parametric model of sodium-fuel interaction; and laboratory experiments and basic studies. (auth)

2465 (CONF-740401-P2, pp 922-934) LARGE SCALE VAPOR EXPLOSIONS. Henry, R. E.; Gabor, J. D.; Winsch, I. O.; Spleha, E. A.; Quinn, D. J.; Erickson, E. G.; Heiberger, J. J.; Goldfuss, G. T. (Argonne National Lab., IL). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

Large scale thermal interaction studies have been carried out with both simulant fluids and reactor materials to investigate the validity of proposed vapor explosion models and the likelihood of such events in a liquid metal fast breeder reactor. Experimental results with Freon-22 and water show that the interface temperature, homogeneous nucleation model accurately predicts the necessary temperature conditions for the onset of large scale vapor explosions. Test results for many different contact modes revealed that, although the same thermal criteria for the onset of large scale explosions were observed in all modes of contact, the magnitudes of explosions were highly dependent upon contact mode. Large scale thermal interaction experiments with reactor materials, in which molten uranium dioxide was injected below the surface of a sodium pool, did not produce any measurable thermally explosive events. This result is also in agreement with the interface temperature, homogeneous nucleation model. (auth)

2466 (CONF-740401-P2, pp 937-954) MECHANISM OF FRAGMENTATION DURING MOLTEN FUEL/COOLANT THERMAL INTERACTIONS. Caldarola, L.; Kastenberg, W. E. (Kernforschungszentrum, Karlsruhe, Ger.). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

A mathematical model for the fragmentation of UO_2 during the molten UO_2/sodium thermal interaction is presented. The model is based upon results of simulation experiments with metal/water interactions in which bubble vapor growth and collapse is observed. Preliminary numerical calculations with the model yield qualitative agreement with molten stainless steel/sodium experiments and have a similarity to the recently published pressure/temperature, unstable film boiling curve of Farahat. Areas of needed improvements in the model are also presented. (auth)

2467 (CONF-740401-P2, pp 955-968) IMPROVEMENTS IN MODELING FUEL–COOLANT INTERACTIONS AND INTERPRETATION OF THE S-11 TREAT TEST. Erdman, C. A.;

Garner, P. L.; Haas, P. M.; Reynolds, A. B. (Univ. of Virginia, Charlottesville). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

Three constraint models used in fuel-coolant interaction (FCI) calculations are compared, including a new two-dimensional constraint. The new constraint model provides an estimate of energy partitioning not available from the two other constraints. A simple model for representing heat losses from the FCI zone is described. Validity of the model for FCI calculations is demonstrated by comparison with a more complex model. The effect of zone heat losses on FCI calculations is shown for three different sets of initial FCI zone conditions. The three cases represent a range of conditions over which the effect of zone heat losses varies markedly. For the case representing the most energetic interaction, little reduction in expansion work is realized by consideration of heat losses. Additional analysis of the S-11 TREAT test is presented, showing the importance of FCI zone heat losses in reducing calculated sodium vapor pressures. A discussion of the role of fuel vapor pressure in interpretation of the initial pressure pulses is also presented. Recently published estimates of fuel vapor pressures appear to be inconsistent with the theory that the initial 150 atmosphere pulse was caused primarily by fuel vapor. (auth)

2468 (CONF-740401-P2, pp 969-991) THEORETICAL MODEL WITH VARIABLE MASSES FOR MOLTEN FUEL–SODIUM THERMAL INTERACTIONS. Caldarola, L.; Koutsouvelis, G. (Kernforschungszentrum, Karlsruhe, Ger.). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

In the model proposed, the reaction has been assumed to occur in two successive phases, which have been called respectively phase A and phase B. In phase A a given number (function of time) of fuel particles come in intimate contact with a given mass of liquid sodium (function of time). The heat transfer process is characterized by very good thermal contact between the fuel and the coolant, and by a large contact area due to the small size of the particles. The heat transfer coefficient decreases with time due to the formation of a temperature profile inside the fuel particles. The heated volume of sodium is constrained by the surrounding unheated coolant and by the other materials present in the core. The mechanical constraint is schematized by a sodium column of finite length above the reaction volume. The sudden expansion of the heated volume first produces acoustic waves which travel along the sodium column. Later the sodium column behaves like a piston which is pushed inertially upwards. The pressure rises, reaches a maximum, and then falls as soon as the expansion of the liquid sodium becomes important. At the time at which the pressure reaches the saturation point, sodium boiling starts and phase B begins. The heat transfer process is now characterized by a very large contact area, and by a thermal contact between the fuel and the coolant which becomes increasingly worse with time, due to the formation of a sodium vapor layer at the external surface of the fuel fragments. The sodium will boil in a large quantity, and will produce therefore large volume changes. The sodium piston will be further accelerated and its movement will allow the pressure in the reaction volume to decrease. The time history of each fuel particle is taken into account and the heat transfer coefficient during phase B is based on experimental evidence. A size distribution of fuel particles has also been incorporated in the model. Numerical evaluations are also included and discussed. (auth)

2469 (CONF-740401-P2, pp 992-1005) SOME ASPECTS OF LIQUID–LIQUID HEAT TRANSFER AND EXPLOSIVE BOILING. Fauske, H. K. (Argonne National Lab., IL). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

Characteristics of liquid–liquid heat transfer and nucleation are discussed. Vapor explosion mechanisms are examined and some examples are described. The molten UO_2–Na system found in LMFBR accident conditions is discussed. (JWR)

2470 (CONF-740401-P2, pp 1021-1040) SAFETY DESIGN APPROACH TO THE PEC REACTOR. Palamidessi, A. (CNEN, Bologna). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The design and evaluation approach used to assure safety in the PEC reactor are discussed. Safety goals were established to guide design and to provide assurance of adherence with general safety principles. Accident initiating causes were identified and design criteria used to reduce their probability. All expected accident propagations from initiating events throughout postulated malfunctions of protective systems were carefully assessed by means of fault-tree techniques to reduce the total probability of accidents causing serious consequences below an acceptable level. In the definition of the safety goals a semi-probabilistic approach was used, based mainly on quality standards of systems and equipment and on redundancy, separation, and independence criteria. Quality standards are intended to cover design, fabrication, inspections, testing procedures, maintenance, spare provisions, etc. Some postulated faults are surveyed and engineered safety features and protective systems to prevent the accidents or mitigate the consequences are discussed. The extremely improbable or hypothetical occurrences in which the protective systems are assumed to fail to derive design basis conditions are briefly described. (auth)

2471 (CONF-740401-P2, pp 1061-1082) DESIGN AND SAFETY STUDIES FOR A 1000 MW(e) GAS-COOLED FAST REACTOR. Goetzmann, C. A. (Kraftwerk Union AG, Erlangen, Ger.); Dalle Donne, M. 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

Work that is currently being done in the Federal Republic of Germany on the design and safety aspects of a large 1000 MW(e) Gas Cooled Fast Reactor is reviewed. Mention is made of the concurrent experimental program aimed at the inpile testing of a reduced sized fuel element having features typical for the gas cooled fast reactor system. The design studies comprise the layout of both the primary and secondary system, the latter to the extent necessary to determine its feed back on the primary system. Data relating to the nuclear and thermo-hydraulic core design and its dependence on enrichment are summarized. The preliminary reference design selected features a relatively low fissile rating of 0.78 MW/kg. Safety studies include the analysis of the transient behavior of the plant under various accident conditions including the design basis accident. It is shown that the GCFR system can be designed to meet the expected safety criteria in the Federal Republic of Germany. In particular it is shown that decay heat removal under depressurized conditions can be assured to a very high degree of confidence. This is of special importance since natural convection does not suffice to remove decay heat with the present GCFR-layout. (auth)

2472 (CONF-740401-P2, pp 1083-1104) SAFETY-RELATED DESIGN FEATURES AND CRITERIA OF THE GAS-COOLED FAST BREEDER REACTOR. Larrimore, J. A. (General Atomic Co., San Diego, CA). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The Gas-Cooled Fast Breeder Reactor (GCFR) has been under development at General Atomic Company (GA) since 1962 and is based on the technology developed for the High-Temperature Gas-Cooled Reactor (HTGR). Inherent and design safety features of the GCFR are discussed and related to those of the HTGR in the areas of reactor coolant, reactor vessel, heat-removal systems, reactivity control and shutdown systems, core support system, and fuel. General safety design criteria for the GCFR are presented that have evolved from extensive safety evaluations as a means for classifying transients and accidents. This framework is used to show the substantial capability of the GCFR to withstand the whole spectrum of potential off-design conditions and equipment malfunctions and failures. (auth)

2473 (CONF-740401-P2, pp 1105-1118) ENGINEERED SAFEGUARDS AND THEIR IMPLICATIONS FOR THE GBR-4 DESIGN. Chermanne, J.; Yellowlees, J. M.; Vleider, G.; Burgsmueller, P.; Sacriste, C. (European Association for the Gas Breeder Reactor, Brussels). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The inherent safety features and engineered safeguards of a commercial Gas-cooled Breeder Reactor are described. The reliability of the reactor tripping, the heat removal from the core and the radiological safeguards are emphasized. The conclusion is drawn that, using conventional gas-cooled reactor engineering practice, the Gas-cooled Breeder Reactor can be made as safe as any other reactor system without losing its economic competitivity. (auth)

2474 (CONF-740401-P3) PROCEEDINGS OF THE FAST REACTOR SAFETY MEETING, BEVERLY HILLS, CALIFORNIA, APRIL 2–4, 1974. (American Nuclear Society, Los Angeles, Calif.). 1974. 604p. Dep. NTIS $13.60.

Information on fast reactors is presented concerning sodium boiling and flow blockage, accident analysis, alternate shutdown systems, instrumentation and probability evaluation, and selection of safety design bases for fast power reactors. Separate abstracts are included for 36 of the 39 papers presented. Three of the papers have previously been abstracted and included in NSA under the following abstract numbers: 29:31235, 30:11936, and 30:2068. (DCC)

For abstracts of individual papers see: 2360–2369, and 2475–2500.

2475 (CONF-740401-P3, pp 1121-1138) SODIUM BOILING EXPERIMENTS AND THEIR IMPORTANCE FOR THE REACTOR SAFETY. Gast, K.; Peppler, W.; Smidt, D. (Kernforschungszentrum, Karlsruhe, Ger.). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

Within the scope of the R and D program of the LMFBR's (SNR) the behavior of local and integral cooling-disturbances in subassemblies is investigated up to boiling. As starting conditions these processes are of great interest with respect to the following safety problems: the failure propagation and the course of severe hypothetical accidents. A short survey is given on the different safety requirements with respect to the national reactor concepts. The Karlsruhe work on the problems of cooling disturbances, detection and sodium boiling is reviewed and future prospects are indicated. 18 references. (auth)

2476 (CONF-740401-P3, pp 1161-1172) STUDIES OF THE DEVELOPMENT OF COOLANT BOILING IN A FAST REACTOR. Clare, A. J.; Board, S. J.; Hall, R. S. (Central Electricity Generating Board, Berkeley, Eng.). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

Information obtained about the onset and development of coolant boiling in a fast reactor is of considerable importance in determining its ultimate safety consequences and is also essential as an aid to quantifying the detectable signals which may be generated by the processes. Experiments in a water rig are described which aim to define the temperature distribution around blockages in a pin-cluster, and the consequent coolant boiling patterns. Analysis of the data has shown the effects of the interaction of the vapor bubbles with the flow and temperature fields. The requirements of a coolant boiling model are discussed, including the effect of perturbations such as the release of gas from failed fuel pins. The implications of the program of work on reactor safety and fault detection are discussed. 14 references. (auth)

2477 (CONF-740401-P3, pp 1173-1187) MEASUREMENT OF THE LIQUID METAL RESIDUAL FILM LEFT BEHIND COOLANT EXPULSION IN NARROW CHANNELS. Kottowski, H. M. (EURATOM, Ispra, Italy); Moi, M. J.; Morandi, A.; Pancaldi, E.; Zurli, A. 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

In order to obtain quantitative information on the hydrodynamics of the liquid metal film, which has been left behind a coolant ejection in a channel, the following experimental and theoretical program has been accomplished: a) measurement of the local and average film thickness as a function of: overpressure Δp between the (vapor) bubble and the blanket (i.e., velocity and acceleration of the coolant during the ejection), and diameter of the channel; b) measurement of the onset of turbulence; and c) development of theoretical equations for the calculation of the film thickness. 8 references. (auth)

2478 (CONF-740401-P3, pp 1188-1201) SODIUM EXPULSION TESTS FOR THE SEVEN-PIN GEOMETRY. Henry, R. E.; Singer, R. M.; Lambert, G. A.; McUmber, L. M.; Quinn, D. J.; Spleha, E. A.; Erickson, E. G.; Jeans, W. C.; Parker, N. E. (Argonne National Lab., IL). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

Sodium expulsion data are reported for single- and seven-pin geometries with LMFBR heat flux conditions following pump coastdown flow transients. Analysis of the data shows that in both cases boiling inception occurred at the end of the heated zone with a small superheat. Net positive flow was observed during the early voiding stage and the general flow pattern appears to be annular. 7 references. (auth)

2479 (CONF-740401-P3, pp 1202-1219) OUT-OF-PILE STUDIES IN FRANCE ON SODIUM BOILING. Costa, J. (CEN, Grenoble, France); Lafay, J.; Plas, R.; Rousseau, J. C.; Teytu, A.; Menant, B.; Schmitt, F. 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The effort being made at the C. E. A. on out-of-pile studies on sodium boiling is described. Progress concerning the different stages of the program is given for: development of high heat flux heaters; single and multi-pin boiling experiments in sodium and water; and computer codes. 12 references. (auth)

2480 (CONF-740401-P3, pp 1223-1240) CRITICAL DISCUSSION OF SOME IMPORTANT TOPICS IN FAST REACTOR SAFETY ANALYSIS. Angerer, G.; Eisemann, E.; Fischer, E. A.; Jacobs, H.; Kuesters, H.; Mayer, L.; Schmuck, P.; Thiem, D. (Kernforschungszentrum, Karlsruhe, Ger.). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The theoretical safety analysis of LMFBRs presently concentrates on a mechanistic description of accident sequences which coincide with a complete failure of the reactor safety system. These unprotected accidents may lead to a disassembly of the core. The uncertainties which are due to neutronic and non-neutronic methods and data are discussed, and the impact of these uncertainties on important safety characteristics of the reactor has been investigated in various sensitivity studies. By this procedure, the most relevant uncertainties are identified. It is found that presently essential experimental verifications on certain hypothesized phenomena in the areas of pin failure, fuel coolant interaction, fuel movement, and fuel slumping are lacking. Therefore, some rules for a conservative safety approach on the basis of present knowledge are defined. A few experiments are suggested, which are suitable to narrow the range of uncertainties, and allow to reduce the conservatism of the assumptions. In the near future, this experimental effort should have a higher priority than further theoretical speculation. 37 references. (auth)

2481 (CONF-740401-P3, pp 1241-1264) TRENDS IN LMFBR HYPOTHETICAL-ACCIDENT ANALYSIS. Jackson, J. F.; Stevenson, M. G.; Marchaterre, J. F.; Sevy, R. H.; Avery, R.; Ott, K. O. (Argonne National Lab., IL). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The role that hypothetical core disruptive accidents (HCDAs) should play in the overall safety evaluation of fast reactors has not always been well defined nor universally agreed upon. They have become a traditional consideration in LMFBR safety, however. The current philosophy in the United States embraces three levels of safety consideration in fast reactor design. The first level emphasizes proper design and construction in order to produce an inherently safe and reliable reactor. The second level provides protection systems to ensure that any off-normal conditions can be safely arrested or accommodated. The third level considers special features that provide an additional margin of public protection in case extremely unlikely or unforeseen circumstances should arise. HCDAs are usually considered as part of this third-level evaluation. The extent to which core disruptive accidents should be considered in reactor design is a matter of continuing debate. There is the usual trade-off between safety and economics that exists in almost any other engineered product. Providing a design that would accommodate the consequences of an overly conservative and unrealistic HCDA could impose undesirable economic penalties. On the other hand, the need for adequate public protection is obvious. A primary difficulty in executing the third level of safety is in determining the type or range of events that should be considered as "realistic." The mechanistic approach to accident analysis is being developed to aid in making rational judgments in this area. Instead of merely postulating seemingly conservative conditions that lead to severe excursions, the mechanistic approach attempts to analyze accident sequences from some initiating event up to the conclusion of the accident. The status of the mechanistic approach is reviewed with an emphasis on several trends that have recently evolved. 43 references. (auth)

2482 (CONF-740401-P3, pp 1290-1302) SOME PROBLEMS CONCERNING FAST REACTOR SAFETY. Antonakas, D. (CEA, Cadarache, France); Fortunato, M.; Meyer Heine, A.; Francois, P. 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

All the probable accidents are treated in a mechanistic way; that is to say to be able to describe the trees of events issued

from any initial defect, qualitatively and quantitatively. Then, by estimating the limits of the containment, it would be possible to "locate" the vessel among all the defects classified by order of importance. It is quite obvious that some accidents cannot be classified in this list. These are the unrealistic accidents which are not related by definition to any known initial cause. Although these accidents must not be taken into account, it may be useful to investigate them. In a first part, the courses of events which can be described in a mechanistic way are analyzed; classical incidents such as a blockage, or accidents which assume a simultaneous failure of two levels of protection-detection and shutdown. In a second part, a parametric analysis of an unrealistic accident is performed. This will be given as an example in order to illustrate the possibilities of the codes under development in the CEA. Finally, the response of the containment devices to mechanical energy releases is investigated. (auth)

2483 (CONF-740401-P3, pp 1303-1321) CURRENT STATUS AND EXPERIMENTAL BASIS OF THE SAS LMFBR ACCIDENT ANALYSIS CODE SYSTEM. Stevenson, M. G.; Bohl, W. R.; Dunn, F. E.; Heames, T. J.; Hoppner, G.; Smith, L. L. (Argonne National Lab., IL). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The SAS integrated accident-analysis code system has been under development for some time. The latest version, SAS3A, includes models which allow an integral treatment of both transient overpower and loss-of-flow unprotected accident sequences through fuel-pin disruption and up to the point of subassembly disruption. In some cases, these models can follow the sequence from initiation to neutronic shutdown by dispersive fuel motion and can be used to evaluate the possibility of establishing in-place cooling. For cases which proceed to an energetic core disassembly, the new models provide an improved definition of core conditions and reactivity insertion rate at the time of a transition to VENUS-II. The new capabilities provided by SAS3A include a steady-state fuels-initialization routine, a primary-loop hydraulics model, a fuel-coolant-interaction model for transient overpower conditions, a new moving-film treatment in the multibubble sodium-boiling model, and cladding and fuel motion models for voided assemblies in a loss-of-flow accident. 42 references. (auth)

2484 (CONF-740401-P3, pp 1322-1332) COMPARISON STUDY AND ANALYSIS OF MODELS FOR 1000 MW(e) AND 4000 MW(e) LMFBR HYPOTHETICAL ACCIDENTS. Bleiweis, P. B.; Okrent, D.; Kastenberg, W. E. (Univ. of California, Los Angeles). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

A 1000 MW(e) and two 4000 MW(e) LMFBR's were analyzed for unprotected loss-of-coolant flow and reactivity insertion accidents using a version of the SAS-VENUS computer code. For similar accidents, the final energy deposited in the molten fuel increased nearly directly proportional to the core mass. A four zone, more highly flattened 4000 MW(e) reactor yielded between 5% and 15% more energy in molten fuel than a two zone reactor for the same accident conditions. The energy yields were relatively insensitive to the assumed values of sodium superheat. The computer code was found to introduce potentially large errors because of the manner in which reactivity insertion rates were selected for the disassembly phase at the time of switching to the VENUS module (at a pre-specified peak core fuel temperature). Further attention should be given to this aspect of coupled-code accident analyses. 4 references. (auth)

2485 (CONF-740401-P3, pp 1333-1346) EQUATION OF STATE OF MIXED OXIDE FUEL FOR THE ANALYSIS OF FAST REACTOR DISASSEMBLY ACCIDENTS. Bogensberger, H. G.; Fischer, E. A.; Schmuck, P. (Kernforschungszentrum, Karlsruhe, Ger.). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The vapor pressure for mixed oxide is calculated by following the method used by Rand and Markin. The vapor pressure of the fission products is also calculated and found to be much larger than that of mixed oxide at temperatures around the melting point. The disassembly phase of an unprotected reactivity accident in a LMFBR is analyzed using these vapor pressure data. The accident is initiated by a 5 $/sec reactivity ramp; the predisassembly part was analyzed earlier with the SAS-2A code. It is found that the vapor pressure of the fission products has the effect of greatly reducing the energy release in the accident. 14 references. (auth)

2486 (CONF-740401-P3, pp 1452-1480) COMPARATIVE STUDY OF THE SAFETY OF LIQUID METAL COOLED AND GAS COOLED FAST REACTORS. Cave, L. (Pollution Prevention (Consultants) Ltd., Crawley, Eng.). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

A comparative study of safety should be made on a quantitative basis within a framework which takes into account the fact that to improve the safety of a reactor is likely to increase its cost and could render it uncompetitive with rival systems. Although there are a number of uncertainties about both breeder systems that prevent the making of a completely quantitative study, the growing acceptance of the cost/benefit concept does lead to the possibility of making a useful comparison at the present time, using a relatively simple method, but it is not yet possible to take economic factors fully into account. Ideally the study should compare safety in normal operation, as well as in accident conditions. The principal features of the method used in this paper are as follows: a quantitative standard of safety is defined which is common to both systems; the possibility of attaining this standard of safety in each system with feasible design features, largely irrespective of cost, is examined; the effect of substantial changes in the basic assumptions, including the standard of safety required, on design feasibility are investigated; and the effect on safety of the generating costs and doubling times predicted for the two systems are examined, taking into account factors which may lead to differences in availability. The effects on safety of the differences between the main variants of each system (i.e., "pool" and "loop" type LMFBR; upward and downward core flow GCFR) are examined briefly. 28 references. (auth)

2487 (CONF-740401-P3, pp 1493-1507) USE OF LEAK PATH ANALYSIS IN FAULT TREE CONSTRUCTION FOR FAST REACTOR SAFETY. Fullwood, R. R.; Erdmann, R. C. (SAI Services, McLean, VA). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

A method for determining the top of a fault tree for an accidental release of radioactivity is described with application to the FFTF. The analysis leads from design drawings and related information to a logical expression for the failure paths. This algebraic expression, when reduced, is represented by a fault tree. Additional trees are also drawn for other parts of the system. The results of the method are compared to alternate schemes and the concept of fault tree completeness is considered. 14 references. (auth)

2488 (CONF-740401-P3, pp 1525-1540) CAPRI: COMPUTER CODE FOR THE ANALYSIS OF HYPOTHETICAL CORE DISRUPTIVE ACCIDENTS IN THE PREDISASSEMBLY PHASE. Struwe, D.; Royl, P.; Wirtz, P.; Kuczera, B.; Angerer, G.; Fischer, E. A. (Kernforschungszentrum, Karlsruhe, Ger.). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The newly developed code system CAPRI-2 is described. Results of a parametric study for the predisassembly phase of hypothetical core disruptive accidents for the Mark I-core of the SNR-300 are presented. For the overpower accident the influence of different ramp rates and for the pump flow coast down the influence of different thermohydraulic design data is analyzed. 11 references. (auth)

2489 (CONF-740401-P3, pp 1541-1555) IMPROVED ANALYSIS OF FUEL MOTION DURING AN OVERPOWER EXCURSION. Wider, H. U.; Jackson, J. F.; Smith, L. L.; Eggen, D. T. (Argonne National Lab., IL). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

During an overpower excursion in a LMFBR, irradiated fuel pins are expected to rupture and eject molten fuel and fission gas into the coolant channels. The ejected fuel is subsequently displaced by the initial sodium momentum, by pressures resulting from fuel-coolant thermal interactions (FCI), and by fission gas released through the clad rupture. This fuel and sodium motion in the core region affects the reactivity of the reactor and determines the ultimate course of the neutronics transient. For example, if the fuel is swept out of the core region, it could potentially terminate the excursion. The results of PLUTO, a new model for predicting this fuel and sodium motion, are compared with SAS/FCI, a current fuel-coolant interaction model used in whole-core

accident analysis. The objective of this comparison is to evaluate assumptions made in current models and to determine the need for more detailed, sophisticated methods. 9 references. (auth)

2490 (CONF-740401-P3, pp 1556-1571) FUEL MOVEMENT INVESTIGATIONS DURING LMFBR OVERPOWER EXCURSIONS USING A NEW MODEL. Rumble, E. T. III; Kastenberg, W. E.; Okrent, D.; Cermak, J. O. (Univ. of California, Los Angeles). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

Several physical models approximated in a computer simulation of the predisassembly phase of LMFBR overpower excursions are described. Results are presented showing clad failure predictions, fuel movement and related phenomena. 14 references. (auth)

2491 (CONF-740401-P3, pp 1590-1602) SIMULATION OF AN UNPROTECTED OVERPOWER ACCIDENT IN THE SNR-300 WITH THE SAS3A CODE. Royl, P.; Smith, L. L.; Stevenson, M. G. (Argonne National Lab., IL). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The unprotected overpower accident in an LMFBR is one of the hypothetical core disruptive accidents whose analysis is usually considered in the design and licensing of the reactor. Two recently developed modules of the SAS3A computer program permit a more detailed analysis of this accident. Failure conditions such as time and position of clad failure can be determined from the fuel and clad mechanical interaction predicted by the DEFORM-II module. After clad failure the SAS/FCI module predicts the ejection of molten fuel and fission gas into the sodium coolant, the thermal interaction between fuel and sodium, and the reactivity feedback from the fuel motion and the sodium voiding. In addition, fuel restructuring and burnup effects, such as fission-gas retention and swelling on which the failure conditions and fuel ejection strongly depend, can be determined internally by a steady-state fuel characterization routine. Some results for an unprotected $1/sec overpower accident in the SNR-300 calculated with this improved computer program are presented. The calculations were done for a 100-day core and for an equilibrium core at the beginning of the 117-day fuel cycle. Clad failure was predicted by three different failure criteria. 12 references. (auth)

2492 (CONF-740401-P3, pp 1603-1618) GBR-4 PROTECTION SYSTEMS: FAILURES AND THEIR CONSEQUENCES. Burgsmueller, P. (Gas-Cooled Breeder Reactor Association, Brussels). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

In the GBR-4 design of a gas-cooled fast reactor, emphasis is placed on using to advantage the single-phase character of the coolant. Specific features of the protective systems are fail-safe neutron absorption, permanently operating auxiliary supplies and atmospheric pressure cooling. For transient analysis a computer program is applied using a point reactor model for heat transfer and neutron kinetics. A dynamic steam generator code has been employed to describe secondary side effects. Anticipated disturbances in operation are reactivity insertion, loss of supplies and loss of coolant pressure. For these accidents, failures in reactor protection are postulated in decreasing order of probability. The consequences are analyzed and discussed. The results lead to the conclusion that, owing to the inherent characteristics of the system and to the specific design, occurrences are well within the limits of a typical probability-release criterion. 15 references. (auth)

2493 (CONF-740401-P3, pp 1619-1631) SAFETY ANALYSES OF A 300-MW(e) GAS-COOLED FAST BREEDER REACTOR. Buttemer, D.; Chi, H.; Reinsch, W.; Torri, A. (General Atomic Co., San Diego, CA). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

Extensive safety evaluations of the 300-MW(e) GCFR demonstration plant to determine the response to anticipated plant transients and to postulated accidents are summarized. Cases presented include normal reactor trip, loop isolation, control-rod withdrawal accidents, accidents involving malfunctions in the circulator control valves, and depressurization accidents. The results are very encouraging with respect to the capability of the GCFR to safely accommodate the spectrum of cases investigated without exceeding fuel or coolant-system safety limits. 4 references. (auth)

2494 (CONF-740401-P3, pp 1635-1646) SELECTION OF SAFETY DESIGN BASIS OF FAST REACTORS IN THE FEDERAL REPUBLIC OF GERMANY. Smidt, D. (Kernforschungszentrum, Karlsruhe, Ger.). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The safety design basis of fast reactors to a very great extent is determined by design basis accidents. DBA's are described for the SNR-300 and compared to those for LWR's. For future large fast reactors too conservative assumptions with respect to the whole core accident may lead to serious feasibility problems. Three different strategies for the solution are discussed. 5 references. (auth)

2495 (CONF-740401-P3, pp 1647-1659) SELECTION OF SAFETY DESIGN BASES FOR FAST POWER REACTORS. Graham, J. (Westinghouse Electric Corp., Pittsburgh). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

Fast reactors have been designed in one way or another to accommodate certain hypothetical accidents chosen either to evaluate the extra margin inherent in the design, or to define extra margin by the addition of specific safety features. These hypothetical accidents have ranged from very low probability events chosen to extend the normal failure mode analysis into the hypothetical range, to non-mechanistic and even non-physical conditions. A discussion of the value of this hypothetical safety, its possible consequences and a suggested rational alternative to ensuring the health and safety of the public is presented. Safety design in this context is associated ultimately with the design of containment of fission products. The design bases and previous experience from existing liquid cooled fast reactors is discussed to illustrate the application, use, and consequences of hypothetical safety. The conclusion is that by the application of a more balanced safety approach to a design, the real safety of the plant can be improved by a better assignment of priorities in design and in development activities and by attention to the functional requirements within the plant and the addition of suitable standard margins. 12 references. (auth)

2496 (CONF-740401-P3, pp 1660-1668) ROLE OF HYPOTHETICAL ACCIDENT ANALYSIS IN FAST BREEDER DESIGN AND LICENSING. Nicholson, R. B. (Ohio State Univ., Columbus). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

The study of hypothetical core disassembly accidents is an essential process in the design and licensing of fast breeder reactors. The designer from the beginning of the design process must work toward a containment system that has minimum practicable failure probability for a core disassembly accident in the generic sense, with the specific initiating circumstances unspecified. In some cases this may mean increasing the natural containment capacity for a particular reactor concept several-fold, with associated reduction in failure probability of two orders of magnitude. Studies of specific accident histories are done to guide the designer but are not adequate to determine the bounding energy release on which containment system design is based. The role of engineering judgment in setting safety design criteria and the individuals making the judgments should be given greater visibility. This provides a force of individual responsibility to balance economic forces and it provides a basis for evaluation of the degree of competence associated with the judgments. The experimental program on fast reactor meltdown accidents must be pursued vigorously with new experimental facilities in order to reduce the extent of the judgment factor in the containment design basis. (auth)

2497 (CONF-740401-P3, pp 1669-1673) SELECTION OF SAFETY DESIGN BASES FOR FAST POWER REACTORS. Kintner, E. E. (Atomic Energy Commission, Washington, DC). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

Safety aspects of the LMFBR are discussed concerning the design bases used in the developmental stages of the reactor type. (DCC)

2498 (CONF-740401-P3, pp 1674-1678) SELECTION OF SAFETY DESIGN BASES FOR FAST POWER REACTORS: ANOTHER CATCH 22? Wolfe, B.; Hikido, K.; Meyers, R. (General Electric Co., Sunnyvale, CA). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

An opinion is presented concerning the design considerations for LMFBR safety aspects. (DCC)

2499 (CONF-740401-P3, pp 1679-1682) CONTRIBUTION TO PANEL DISCUSSION ON SELECTION OF SAFETY DESIGN BASES FOR FAST POWER REACTORS. Farmer, F. R. (Safety and Reliability Directorate, Risley, Eng.). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

2500 (CONF-740401-P? pp 1683-1693) SAFETY DESIGN BASIS FOR POWER LMFBR IN FRANCE. Petit, J. (CEA, Saclay, France). 1974.

From conference on fast reactor safety; Beverly Hills, California, USA (2 Apr 1974).

In proceedings of the fast reactor safety meeting.

2501 (CONF-741018-, pp 229-234) ^{14}C GASEOUS EFFLUENT FROM PRESSURIZED WATER REACTORS. Kunz, C.; Mahoney, W. E.; Miller, T. W. (New York State Dept. of Health, Albany). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population exposures.

Samples of decay tank gas and containment air were obtained from the three operating pressurized water reactors in New York State: the Ginna reactor in Rochester and Indian Point 1 and Indian Point 2 in Buchanan. These samples, taken over the past two years, were analyzed for carbon species by chromatographic separation. The ^{14}C activity of the individual compounds was measured by gas proportional counting. In all the samples analyzed, CH_4 and C_2H_6 contained over 80% of the ^{14}C activity, with lesser activities observed for higher hydrocarbons and CO_2. Although the fission product activity in gaseous effluents varied with fuel rod integrity, the production of ^{14}C remained relatively constant. The results indicate that it is produced predominantly in the reactor vessel by the reaction of neutrons with nitrogen and oxygen in the primary coolant. The total yearly gaseous effluent of ^{14}C for a 1,000 MW(e) pressurized water reactor is estimated to be approximately 6 Ci. (auth)

2502 (COO-2152-10) INVESTIGATION OF PRESSURE DROPS AND HEAT TRANSFER COEFFICIENTS FOR LOSS OF COOLANT EVALUATION. Quarterly Progress Report for Period Ending December 30, 1973. Weisman, J. (Cincinnati Univ., Ohio (USA). Dept. of Chemical and Nuclear Engineering). 1973. 18p. Dep. NTIS $4.00.

The objective of this contract is the study of pressure drop and heat transfer phenomena of importance during a loss of coolant accident. The study is divided into three experiments: transient pressure drop investigation; two-phase pressure drop and flow pattern study; and transition boiling and reflooding heat transfer tests. 8 references. (auth)

2503 (CREARE-TN-188) EFFECT OF HOT WALLS ON FLOW IN A SIMULATED PWR DOWNCOMER DURING A LOCA. Block, J. A.; Wallis, G. B. (Creare, Inc., Hanover, N.H. (USA)). May 1974. 37p. Dep. NTIS $4.00.

The results of an experimental program are presented which investigated a number of variables affecting the rate of delivery of emergency core cooling (ECC) water to the lower plenum of a pressurized water reactor (PWR) after termination of blowdown. Specifically, the program investigated the effect of thermal energy stored in reactor vessel and core walls on the flow processes in the downcomer annulus and the possible "hot wall delay" of water penetration into the lower plenum of a PWR during a postulated loss-of-coolant-accident (LOCA). The main variables affecting the hot wall delay period were found to be downcomer length, injection mode, and water temperature. Wall temperature and downcomer gap had a weaker-than-expected effect. In general, the measured delay times were considerably shorter than predicted by a previous one-dimensional analysis. This is attributed principally to the beneficial effects of the non-one-dimensional flow patterns which were found to predominate in small (PWR-like) aspect ratio geometries. Although there are numerous differences between the Creare and LOFT downcomers, the test results suggest that a hot wall delay period in the 5–15 second range is possible in LOFT experiments. (auth)

2504 (CREARE-TN-196) ANALYSIS OF COLD LEG ECC FLOW OSCILLATIONS. Wallis, G. B.; Block, J. A.; Johnson, S. R. (Creare, Inc., Hanover, N. H. (USA)). Aug 1974. 57p. Dep. NTIS $5.45.

A first-order analysis is developed to describe the transient response, including oscillations, of steam and water flows in the cold leg Emergency Core Cooling (ECC) injection region of a Pressurized Water Reactor (PWR). The model provides a description of the overall features of the oscillations, in particular their frequency and amplitude, but cannot duplicate all the details of existing experimental results obtained by Combustion Engineering. Conditions upstream of the ECC injection region are shown to influence the nature and magnitude of the transient behavior. Because of the uncertainties about the actual upstream geometry, a complete comparison between the analysis and the experimental data was not possible. Based on a postulate that plug formation in the cold leg triggers the oscillations, Froude numbers for flow regime transitions are derived from simple models of the flow mechanics. These transition Froude numbers agree fairly well with small-scale air-water experimental results. (auth)

2505 (DEU-73-13) FEASIBILITY STUDY ON THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF THE PROBLEM OF CORE MELTING. Skoutajan, R. (Battelle-Institut e.V., Frankfurt am Main (F.R. Germany)). Jan 1972. 83p. (In German).

Data on the following problems are compiled and examined: (1) physical behavior of the materials contained in the core, (2) their chemical behavior, and (3) energy transformation in the course of steam explosions. A critical analysis of the material shows which data are essential for assessing or controlling the process of core melting and indicates furtner theoretical or experimental research work to be done for completing the data currently available, along with an estimate of expenditures required for this work. (GE)

2506 (DEU-73-15) REPORT ON THE ACTIVITIES OF THE INSTITUT FUER REAKTORSICHERHEIT DER TECHNISCHEN UEBERWACHUNGS-VEREINE E.V., COLOGNE IN 1972. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Koeln (F. R. Germany)). Apr 1973. 140p. (In German).

A detailed survey is presented on the following topics: (1) organization and administration, (2) tasks with the licensing procedure, (3) responsibility of research project work for the former BMBW, (4) division into departments, (5) national and international collaboration, (6) meetings, and (7) reports, publications, and conference contributions. (GE)

2507 (EURFNR-1198) INVESTIGATION OF SPECTRAL SYNTHESIS AND FEW GROUP METHODS FOR FAST REACTOR TRANSIENTS. Terney, W. B.; Srivenkatesan, R. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Jul 1973. 62p. (KFK-1827). Dep. NTIS (US Sales Only) $4.00.

Work performed under United States–Euratom Fast Reactor Exchange Program.

Two methods of calculating fast reactor transients economically are considered: the energy synthesis method and the few group schemes. Two transients of interest for safety studies were considered for a simple representative 1-d fast reactor model. These were a partial voiding transient and a complete voiding and fuel slumping transient. The energy synthesis method gave excellent agreement both statically and transiently with the exact 26 groups results. Only 3 trial functions were used: the unperturbed core and blanket and the perturbed core averaged flux spectra. The weighting functions were their corresponding adjoints. In few group schemes normal flux weighted collapsing and bilinear (flux-adjoint) collapsing were considered. The flux weighted procedure did not really give satisfactory results with even up to 12 groups. However the bilinear flux-adjoint schemes give satisfactory results with only 6 to 8 groups when the unperturbed flux and perturbed adjoint spectra (or vice versa) were used. For cases where the reactivity effects are not so sensitive (away from one dollar), acceptable results were obtained with just the unperturbed fluxes and adjoints. With bilinear collapsing it is necessary to consider discontinuities arising at interfaces between regions where the flux and adjoint-spectra are different. This requires the current conditions to be modified at such interfaces, while the normal few group flux continuity is sufficient. (19 references) (auth)

2508 (EURFNR-1203) CALCULATION OF THE EFFECTS OF FISSION GAS IN A LMFBR FOR THE ANALYSIS OF AN UNPROTECTED OVERPOWER TRANSIENT. Bogensberger, H. G. (Kernforschungszentrum Karlsruhe (F. R. Germany). Projekt Schneller Brueter). Jun 1974. 18p. (KFK-1990). Dep. NTIS (US Sales Only) $4.00.

Work performed under United States–Euratom Fast Reactor Exchange Program.

A distribution model for the noble gases, created by fission, is applied in a computer program. The subroutine LANGZEIT calculates the "long time" behavior of the fission gas in a pin during "steady state" operation. The results of this calculation are used

as the initial conditions for the subroutine KURZZEIT. This code permits the calculation of migration phenomena and pin swelling during an overpower transient. The results for 2 examples are shown and discussed. (10 references) (auth)

2509 (GEAP-13993) PECS-II: A COMPUTER PROGRAM FOR THE PROBABILISTIC EVALUATION OF FUEL ROD FAILURE CAUSED BY FISSION GAS PRESSURE. Temme, M. I.; Atcheson, D. B. (General Electric Co., Sunnyvale, Calif. (USA). Advanced Technology Dept.). Jun 1974. Contract AT(04-3)-893. 236p. Dep. NTIS $7.69.

The PECS-II (Probabilistic Evaluation of Cladding Stress) computer program is described, along with instructions for its use. Monte Carlo simulation is used to calculate probability distributions for LMFBR cladding failure caused by fission gas pressure. The entire reactor core is simulated by dividing the core into groups of fuel rods with similar operating conditions. Importance sampling is applied in order to reduce the number of Monte Carlo samples (and the cost) required for adequate estimation of low values of probability. PECS-II is operational on the Honeywell-6000 computer and the CDC-7600 computer. (auth)

2510 (HEDL-TME-74-2(Vol.3)) HEDL QUARTERLY TECHNICAL REPORT, APRIL, MAY, JUNE 1974. Volume 3. Reactor and Safety Engineering. Slember, R. J. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jul 1974. Contract AT(45-1)-2170. 35p. AT.

FFTF core studies include three-dimensional buckling calculations for several core configurations and calculations of multiplication factors and worths of Ta and ^{6}Li absorbers for cores 3 and 4. Safety studies include calculations of reactor vessel and head response to a loss of flow hypothetical core disruptive accident. (DG)

2511 (HEDL-TME-74-17) EXPERIMENTS ON MELTING AND GAS RELEASE BEHAVIOR OF IRRADIATED FUEL. Slagle, O. D.; Hinman, C. A.; Weber, E. T. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1974. Contract AT(45-1)-2170. 72p. Dep. NTIS $5.45.

Experimental studies of the response of fast flux (EBR-II) irradiated fuel materials during rapid heating in the laboratory are described. Fuel samples within a resistively heated tungsten tube were subjected to thermal transients in a system providing for temperature and pressure measurements, in addition to continuous gamma radiography of the sample. Experimental results are presented for fuel heating rates of 50°–250°C/sec. In contrast to unirradiated UO_2 where melting resulted in a rapid slumping of the fuel to the bottom of the capsule, low power irradiated fuel with uniform fission gas distribution was observed to break apart and disperse during the release of fission gas below the melting point. Extensive fission gas bubble formation was found to occur below the solidus and subsequent bubble expansion resulted in foam-like structures. Less fuel motion was observed in the high power irradiated fuel tests, consistent with the lower gas content and the difference in gas distribution. The major effect of fission gas in the case of high power fuel is to enhance column stability by slowing the downward displacement of the fuel on melting. Measurements of the temperature dependence of gas release indicate that release begins at fuel temperatures near 2000°C and that a significant fraction of the fission gas has been released before the fuel reaches the melting temperature. (auth)

2512 (JAPFNR-165) REVIEW OF THE JAPANESE WORKS ON LIQUID METAL BOILING. Kikuchi, Y. (Power Reactor and Nuclear Fuel Development Corp., Oarai, Ibaraki (Japan). Oarai Engineering Center). 1974. 22p. (PNC-N-941-74-42). Dep. NTIS (US Sales Only) $4.00.

Information on liquid metal boiling characteristics is presented concerning loss-of-flow tests in a single pin annular channel, sodium boiling in a seven-pin bundle, acoustic noise associated with forced-convection sodium boiling in a single-pin annular channel, effects of bowing distortions on heat transfer in a seven-pin bundle, and computer codes for FBR accident analysis. (auth)

2513 (MRR-P-3) BRUCH-D-02: A COMPUTER PROGRAM FOR THE ANALYSIS OF FLUID AND THERMODYNAMIC PROCESSES IN THE PRIMARY CIRCUIT OF PWR TYPE REACTORS IN SEVERE LOSS-OF-COOLANT ACCIDENTS. Program Description. Liesch, K. J.; Steinhoff, F.; Vojtek, I.; Wolfert, K. (Technische Univ. Muenchen, Garching (F. R. Germany). Lab. fuer Reaktorregelung und Anlagensicherung). Jul 1973. 206p. (In German). INIS.

9 refs.; with figs. and tabs. With abstract in German and English.

BRUCH-D-02 is a computer code to investigate blowdown of pressurized water reactors. A double-ended rupture of a main-recirculation line can be simulated at any location between pressure vessel outlet and steam generator (hot leg rupture) or between recirculation pump and pressure vessel inlet (cold leg rupture). (auth)

2514 (MRR-P-3(suppl.1)) BRUCH-D-03: A COMPUTER PROGRAM FOR THE ANALYSIS OF FLUID AND THERMODYNAMIC PROCESSES IN THE PRIMARY CIRCUIT OF PWR TYPE REACTORS IN CASE OF SEVERE LOSS-OF-COOLANT ACCIDENTS. Appendix to the Program Description BRUCH-D-02. Vojtek, I.; Liesch, K. J. (Technische Univ. Muenchen, Garching (F. R. Germany). Lab. fuer Reaktorregelung und Anlagensicherung). Jan 1974. 67p. (In German). INIS.

2 refs.; with figs. and tabs. With abstract.

The computer program BRUCH-D-03 differs from the version BRUCH-D-02 in that the number of control volumes has been increased from 15 to 23. These eight additional control volumes are used to improve the simulation of the steam generator in the circulating loops, with the possibility of taking into account to a certain extent the changes in the heat transfer through the steam generator pipes by using preset, time-independent heat transfer data (primary and secondary loop). Furthermore, the areas 7, 8, 9 and 10 can be used as discharge nodes or injection nodes, requiring likewise the given time patterns of the mass flow and enthalpy for the individual areas. (GE)

2515 (ORNL-TM-4644) REQUIREMENTS FOR HEATERS FOR BLOWDOWN HEAT TRANSFER TESTS IN PRESSURIZED-WATER REACTOR ENVIRONMENTS. Clark, D. L.; Heddleson, F. A.; Lawson, C. G. (Oak Ridge National Lab., Tenn. (USA)). Oct 1974. Contract W-7405-eng-26. 25p. NTIS $4.00.

The general requirements of heaters for the Pressurized-Water Reactor Blowdown Heat Transfer Program are summarized, and the known experiences with heaters used in blowdown heat transfer work are tabulated. Heaters of about 0.422 in. outside diameter and 12 ft heated length (20 ft overall length) are required that can operate at power levels up to about 150 kW with peak heat fluxes of 600,000 Btu hr^{-1} ft^{-2} $(°F)^{-1}$ and axial power distribution profiles similar to those of water-cooled power reactors. Rapid-response thermocouples are required to follow the surface temperature fluctuations during transient tests. (auth)

2516 (ORNL-TM-4736) HTGR SAFETY STUDIES PROGRESS REPORT FOR THE PERIOD ENDING MARCH 31, 1974. Sanders, J. P. (Oak Ridge National Lab., Tenn. (USA)). Oct 1974. Contract W-7405-eng-26. 100p. (GCR-DL-74-1). Dep. NTIS $8.00.

Progress is reported in the following areas: (1) thermal analysis and code development, (2) evaluation of cooling system performance during post-shutdown operation, (3) evaluation of temperature limits for fuel particle coatings, and (4) stress analysis of primary loop components at limiting temperatures. (DG)

2517 (ORNL-TM-4737) HTGR SAFETY STUDIES QUARTERLY PROGRESS REPORT FOR THE PERIOD ENDING JUNE 30, 1974. Sanders, J. P. (Oak Ridge National Lab., Tenn. (USA)). Oct 1974. Contract W-7405-eng-26. 50p. (GCR-DL-74-2). Dep. NTIS $5.50.

Progress is reported in the following areas: (1) thermal analysis and code development, (2) evaluation of cooling system performance during post-shutdown operation, (3) studies of energy release to the containment shell during a design basis depressurization accident, and (4) evaluation of circulator and motor capabilities for the core auxiliary cooling system. (DG)

2518 (ORNL-TM-4739) HTGR SAFETY STUDIES PROGRESS REPORT FOR THE PERIOD ENDING SEPTEMBER 30, 1973. Sanders, J. P. (Oak Ridge National Lab., Tenn. (USA)). Oct 1974. Contract W-7405-eng-26. 19p. (GCR-DL-73-4). Dep. NTIS $40.00.

Progress is reported in the following areas: (1) thermal analysis and code development, (2) evaluation of cooling system performance during post-shutdown operation, and (3) power density distribution studies. (DG)

2519 (ORNL-TM-4741) HTGR SAFETY STUDIES PROGRESS REPORT FOR THE PERIOD ENDING JUNE 30, 1973. Sanders, J. P. (Oak Ridge National Lab., Tenn. (USA)). Oct 1974. Contract W-7405-eng-26. 42p. (GCR-DL-73-3). Dep. NTIS $5.25.

Progress is reported in the following areas: (1) thermal analysis and code development, (2) studies of sensitivity of HTGR fuel performance to material properties and fuel particle design, and (3) fission product transport calculations. (DG)

2520 (SZS-162) REPORT DER STAATLICHEN ZENTRALE FUER STRAHLENSCHUTZ DER DDR. (Staatliche Zentrale fuer Strahlenschutz, Berlin (German Democratic Republic)). Jun 1974. 20p. (In German). Dep. NTIS (US Sales Only) $4.00.

Separate abstracts are included for each of the two articles

presented concerning inspection procedures for nuclear power plants and fracture mechanics for PWR primary coolant circuit pipes. (DCC)

For abstracts of individual papers see: 2327 and 2521.

2521 (SZS-162, pp 2-8) ASPECTS OF PLANNING AND PERFORMANCE OF RECURRING INSPECTIONS IN NUCLEAR POWER PLANTS WITH REGARD TO NUCLEAR SAFETY. Albrecht, L. Jun 1974. (In German).

Recurring inspections are a helpful procedure in increasing safety of nuclear power plants. Though reliability of plant components is not affected the plant is protected from damages by timely failure detection and maintenance. With regard to recurring inspections the following topics are discussed: design of the plant, organizational aspects, frequency and extent, radiation protection, and documentation. 10 references. (auth)

2522 (UCLA-ENG-7450(Vol.1)) SUMMARY OF THE EVALUATION OF SEVERAL ASPECTS OF THE HYPOTHETICAL LOSS OF COOLANT ACCIDENT FOR LIGHT WATER REACTORS. Volume I. Catton, I.; Cermak, J. O.; Kuo, Y. S.; Prajoto; Wazzan, A. R. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Jun 1974. 19p. Dep. NTIS $4.00.

An evaluation of several of the important analytical aspects of the hypothetical loss of coolant accident for light water reactors has been performed and compared to the final acceptance criteria/evaluation model issued by the USAEC in December of 1973. Detailed study and analyses were performed in the areas of blowdown and reflood/spray thermal and hydraulic behavior, physics of decay heat, and fuel rod cladding behavior with respect to metal/water reaction and embrittlement; comparisons were made between these analyses and that of the final acceptance criteria/evaluation model. (auth)

2523 (UCLA-ENG-7450(Vol.2)) EVALUATION OF SEVERAL ASPECTS OF THE HYPOTHETICAL LOSS-OF-COOLANT ACCIDENT FOR LIGHT WATER REACTORS. Volume II. Catton, I.; Cermak, J. O.; Kuo, Y. S.; Prajoto; Wazzan, A. R. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Jun 1974. 178p. Dep. NTIS $12.00.

An evaluation of several of the important analytical aspects of the hypothetical loss of accident for light water reactors has been performed and compared to the final acceptance criteria/evaluation model issued by the USAEC in December of 1973. Specifically, the thermal and hydraulic behavior, physics of decay heat, and material aspects were studied. Results are presented. 104 references. (auth)

2524 EXPANSION OF THE METHOD OF CORRELATED TEMPERATURES TO CLAD AND FUEL DESIGN ANALYSES. Carajilescov, P.; Todreas, N. E. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). Nucl. Eng. Des.; 30: No. 1, 3-19(Jul 1974).

In the thermal design of nuclear reactor cores, specified design limits (temperatures and linear power rating) should not be exceeded by the operating values of certain elements (coolant, clad and fuel). However, a certain number of channels or fuel pins could be permitted to exceed the specified limits without affecting the reactor's safety while still allowing reliable operation. An expansion of the method of correlated temperatures, developed for coolant temperature analysis, was performed to permit clad temperature and fuel centerline melting analyses in reactor core reliability studies. Since generation of random numbers is involved, calculational procedures, tailored to designer needs, were developed in order to reduce computational time. The method is applied to a typical LMFBR core and results are presented for various assumed clad and fuel design limits. (auth)

2525 SEISMIC RESISTANT DESIGN OF SAFETY CLASS STRUCTURES AND EQUIPMENT. Chen, C. (Gilbert Associates, Inc., Reading, Pa. (USA)). Nucl. Eng. Des.; 30: No. 1, 100-110 (Jul 1974).

Some commonly encountered problems in the seismic resistant design of nuclear power plant facilities are discussed. Topics included are ground input motions, local geology versus source mechanism and travel path, three component inputs, torsional responses, floor response spectra, seismic resistant design of heavy equipment, the application of component mode synthesis technique, seismic resistant design of piping systems, equipment qualification by testing, the effects of close modes, underground pipe design, and soil structure interaction. (auth)

2526 SAFETY MEASURES AGAINST MAJOR DAMAGE IN NUCLEAR POWER STATIONS. P. 2. Measures Against Damage Arising from External Influences. Stueger, R. (Babcock-Brown Boveri Reaktor G.m.b.H., Mannheim (F. R. Germany)). pp 39-43 of Nuclear Power Stations-Technology and Insurance. 7th Allianz Technical Colloquium on the 4th December, 1973 in Munich. Muenchen, F. R. Germany; Allianz(1974). (In German).

From 7th Allianz technical colloquium; Muenchen, F. R. Germany (4 Dec 1973). 6 figs.; 7 refs. With abstract in German, French and English.

From the common aspect of the safety of nuclear power stations, the author reports on the reflections of two nuclear power station suppliers regarding safety considerations in connection with damage and the consequences thereof emanating from external influences. The report furnishes an insight into the reflections of one supplier as to what external damage causes can occur and what damage prevention measures are being taken. (GE)

2527 SAFETY MEASURES AGAINST MAJOR DAMAGE IN NUCLEAR POWER STATIONS. P. 1. Measures Against Damage Arising from Internal Causes. Repke, W. (Kraftwerk Union A.G., Frankfurt am Main (F. R. Germany)). pp 33-38 of Nuclear Power Stations-Technology and Insurance. 7th Allianz Technical Colloquium on the 4th December, 1973 in Munich. Muenchen, F. R. Germany; Allianz(1974). (In German).

From 7th Allianz technical colloquium; Muenchen, F. R. Germany (4 Dec 1973). 9 figs.; 4 refs. With abstract in German, French and English.

From the common aspect of the safety of nuclear power stations, the author reports on the reflections of two nuclear power station suppliers regarding safety considerations in connection with damage and the consequences thereof emanating from internal causes. The complex problem of damage originating from the plant itself can be confined on the basis of safety philosophy. The report furnishes an insight into the reflections of one supplier as to what internal damage causes can occur and what damage prevention measures are being taken. (GE)

2528 THE INSURANCE OF TWO NUCLEAR POWER STATIONS AT THE SAME SITE. Feldmann, J. (Allianz Versicherungs-A.G., Muenchen (F. R. Germany). Abt. Technische Versicherungen); Bremkamp, D. (Allianz Versicherungs-A.G., Muenchen (F. R. Germany). Feuerabteilung); Kuhn, O. (Allianz Versicherungs-A.G., Muenchen (F. R. Germany). Abt. Haftpflicht). pp 25-32 of Nuclear Power Stations-Technology and Insurance. 7th Allianz Technical Colloquium on the 4th December, 1973 in Munich. Muenchen, F. R. Germany; Allianz(1974). (In German).

From 7th Allianz technical colloquium; Muenchen, F. R. Germany (4 Dec 1973). 5 figs. With abstract in German, French and English.

With the construction of two nuclear power stations at the same site, a high concentration of values and a sharp increase in the sums insured and required capacity run parallel. On the basis of the three different construction method examples—the mono unit, double unit and twin plant—the report shows what possibilities of cover exist and how the maximum probable loss can be reduced by apportionment into individual complex sectors. A particular problem thereby ensues in respect of nuclear liability insurance, as counter liability claims of the two reactors could lead to the danger of a diminution of the cover for third party victims. Here, a common financial security provision is in any event worth aspiring to. The possibility of choosing between individual coverage models should in future be maintained, despite increasing capacity demands, insofar as technically and economically justifiable limits are thereby adhered to. (auth)

2529 NUCLEAR POWER STATION INSURANCES 1974. Braun, H. (Allianz Versicherungs-A.G., Muenchen (F. R. Germany)). pp 7-9 of Nuclear Power Stations - Technology and Insurance. 7th Allianz Technical Colloquium on the 4th December, 1973 in Munich. Muenchen, F. R. Germany; Allianz(1974). (In German).

From 7th Allianz technical colloquium; Muenchen, F. R. Germany (4 Dec 1973). 3 figs.; 7 refs. With abstract in German, English and French.

The advancement of nuclear energy to the largest growing industry in the Federal Republic of Germany is reviewed. The insurance industry has developed forms of insurance for both the suppliers and the operators of nuclear power stations, which have proved themselves to be "tailor-made" in practice. The technical assistance of the insurer in the field of safety and inspection is a significant factor here. The role of the insurer in connection with nuclear power station insurance is described. A review of the situation outside the Federal Republic of Germany is included. (auth)

2530 REACTOR SAFETY. Kouts, H. J. C. (Atomic Energy Commission, Washington, DC). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 19, 242-259(1974).

From topical conference on energy; Chicago, Illinois, USA (4 Feb 1974). See CONF-740201-.

Basic parameters and safety considerations for nuclear power plants are presented. The development of a reactor safety program is reviewed. The analysis of possible reactor accidents is discussed. (DCC)

2531 SOME DOSIMETRIC MONITORING RESULTS AT THE IRT-1000 NUCLEAR REACTOR IN SOFIA. Mishev, I. T.; Gelev, M. G. (Inst. of Physics, Sofia). Sov. At. Energy (Engl. Transl.); 34: No. 1, 57-59(Jan 1973).

Translated from At. Energ. (USSR); 34: No. 1, 44-46(Jan 1973).

In order to test the reliability of recorded exposure doses, the neutron dose was measured, except for the neutron group of energies 7 to 500 keV, with the aid of film with a correcting pack. The thermal neutron does (E < 0.4 eV) and the fast neutron dose (0.5 MeV < E < 15 MeV), principally, were measured beyond the reactor shielding (here the emulsions were irradiated without a phantom). The γ-radiation dose was determined with the aid of x-ray films. The concentration of radioactive gases was determined with the aid of a high-sensitivity device, while the aerosol concentration was determined through the use of filters. In order to determine the greatest possible individual exposure, the neutron dose and the γ-radiation dose, and also the concentration of aerosols and radioactive gas at places accessible to personnel were measured wherever those variables attained their highest values. Those sites were selected directly on the other side of the biological shielding near the experimental channels, which were most often left open while the reactor was in service. On the basis of those measurements, and with the recommendations made by the International Radiological Protection Commission taken into account, the total exposure dose in rem units was determined. The following assumptions were entertained: 1) the reactor was operating only at its peak power output of 1500 kW; 2) horizontal channels examined were open continuously while the reactor was in service; 3) the personnel were present at the sites surveyed throughout their working time (46 weeks out of the year). The resulting dose was the maximum possible yearly exposure dose. The results of the exposure dose determination indicate that the individual exposure dose to which one worker is subjected in the course of ordinary duties at the reactor is not greater than 1 rem ± 30% in the course of a year (neutrons of energies from 7 to 500 keV are not included). (auth)

2532 TRANSIENT FUEL-CLADDING DEFORMATION ANALYSIS OF THE IN-PILE H3 'TREAT' TEST WITH THE 'SAS2A/DEFORM-II' CODE. Royl, P.; Watanabe, A.; Agrawal, A. (Argonne National Lab., Ill. (USA)). Nucl. Eng. Des.; 27: No. 3, 299-314(Jul 1974).

A new model for the transient fuel-pin deformation analysis has been developed for oxide-fueled fast breeder reactors. The model, designated as DEFORM-II, is a module of the SAS2A fast-reactor accident analysis code, and is currently used for calculations of fuel behavior in unprotected overpower transients in FFTF and in support of the TREAT program at Argonne National Laboratory. DEFORM II has a new rheological model which allows a more general description of inelastic behavior in both fuel and cladding material with arbitrary yield surfaces, which can be specified temperature, strain, and strain rate dependent. The new model also recognizes some of the most important changes in both fuel and cladding behavior due to steady-state irradiation. This SAS2A/DEFORM-II code system has been used to analyze the transient fuel-cladding deformation for the H3 in-pile TREAT test, during which a pre-irradiated fuel pin was subjected to an overpower transient corresponding to a $0.5-1/sec power ramp in FFTF. The code predictions agreed reasonably well with the observations for this test. A complete documentation of all material data used for the analysis of this test is given in the appendices. (auth)

Reactor Theory and Calculation

Refer also to abstracts 1995, 2337, 2372, 2373, 2382, 2385, and 2507.

2533 (AED-CONF-74-002005) USE OF TRANSIENT MODELS IN SYSTEM ANALYSIS. Frisch, W.; Hoeld, A. 1974. 4p. (In German). (CONF-740129-1).

From 2nd information meeting of the Laboratorium fuer Reaktorregelung und Anlagensicherung; Munich, F. R. Germany (16 Jan 1974).

Transient models developed by LRA in connection with reactor and system dynamics problems are described. The different mathematical models reviewed are classified as linear system models, non-linear core models and non-linear system models. (GE)

2534 FAST NEUTRON LEAKAGE SPECTRA FOR ASSEMBLIES CONTAINING THORIUM, D_2O, AND NATURAL URANIUM. Hughes, T. E. C. Blacksburg, VA; Virginia Polytechnic Inst. and State Univ. (1974). 64p. University Microfilms Order No. 74-20,368.

Thesis (Ph. D.).

Integral measurements with a ^{3}He spectrometer were made to test the validity of the differential data of the ENDF/B-II files for thorium, natural uranium and heavy water. The experimental measurements of fast neutron spectra were conducted in two lattices of thorium metal and D_2O, a cylindrical array of close-packed natural uranium metal slugs in air, a D_2O sphere and cylinder, and a cylinder of thorium nitrate. A ^{235}U fission disc, irradiated by a beam of thermal neutrons from the V.P.I. & S.U. reactor, provided a fast neutron source. Neutron leakage spectra were taken over the energy range between 100 keV and 1.65 MeV. The spectrometer was calibrated using neutrons from the ^{3}H(p,n)^{3}He reaction in a Van de Graaff accelerator. Experimental results were compared with leakage spectra calculated with the multigroup transport code, ANISN. For the thorium metal and D_2O lattices and for the D_2O sphere and cylinder, agreement between calculated and measured spectra was attained confirming the validity of the ENDF/B-II cross-sections and pointing to the usefulness of the ^{3}He spectrometer for fast neutron leakage spectra determinations. For the natural uranium assembly, the calculated leakage spectrum between about 0.743 MeV and 1.65 MeV was significantly below the measured spectrum. As a further test of the applicability of the calculational procedures and ^{238}U cross-sections, transport analysis using the ANISN code was applied to predict the central spectrum of the Japanese Atomic Research Institute (JAERI) I-5 fast assembly. These calculations were compared with the results of published ^{3}He spectrometer measurements of the fast neutron spectrum for this 20% enriched uranium assembly. The results of the comparison reveal a measured spectrum slightly harder than the spectrum determined by the calculations using ENDF/B-II cross-section data. (Diss. Abstr. Int., B)

2535 A COMPILATION OF ROD ARRAY CRITICAL HEAT FLUX DATA SOURCES AND INFORMATION. Hughes, E. D. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)); Ka-Lam, I.; Baker, A. N.; Carbon, M. W. (Wisconsin Univ., Madison (USA)). Nucl. Eng. Des.; 30: No. 1, 20-35(Jul 1974).

The geometric characteristics of rod array test sections employed in critical heat flux (CHF) tests with water coolant, and the ranges of the operating parameters for the tests, are presented for 126 test sections. The corresponding 4277 CHF data points have been stored on a magnetic tape for ease of reference and analysis. A versatile computer program associated with the data library has been used to determine the distributions of the data with respect to geometric a d operating parameters. The dependence of CHF on operating parameters and the importance of subchannel conditions are shown through the use of some of the data. Tables are given for CHF data with a Freon coolant, for CHF data from test sections which only simulate a rod array, and for CHF data for transient situations. (auth)

2536 BINARY SIGNALS CONSTRUCTED FROM WALSH SEQUENCES FOR REACTOR DYNAMICS MEASUREMENTS. Albrecht, R. W.; Wright, S. A. (Univ. of Washington, Seattle). Nucl. Sci. Eng.; 55: No. 3, 296-306(Nov 1974).

Walsh functions are used to construct binary signals suitable for reactor dynamics testing. It is shown that these signals have many properties which may make them preferable to binary signals constructed from a trigonometric basis set. It is further shown that system response characteristics determined on the basis of input/output analysis are identical to Fourier analysis if the Walsh basis set is used and the system is unperturbed by noise. If noise is present in the system response function, it is shown through sample calculations that the squared error of the transfer function estimate is approximately 50% smaller using signals and analysis based on the Walsh basis functions than is found using trigonometric basis functions. (auth)

2537 TIME-DEPENDENT NUCLEAR REACTOR WITH FEEDBACK. Nguyen, D. H. (Naval Postgraduate School, Monterey, CA). Nucl. Sci. Eng.; 55: No. 3, 307-319(Nov 1974).

Transient solutions of a nonlinear nuclear reactor with various temperature-dependent feedbacks are obtained by the modified Newton-Raphson-Kantorovich's iterative technique. The difference between the first and higher iterates is shown explicitly to be negligible at all times, so that the first iterate represents well the entire solution. It is also shown that the spatial distribution of the neutron flux during transients is dominated by the fundamental mode and that the negligible difference between the second and the first iterates is composed of higher harmonics. The maximum flux, the time at which it occurs, and the rate of flux increase

are all readily obtained from the solutions. For an increase in reactor buckling and for a positive initial flux disturbance, the neutron flux in a reactor with Newtonian or prompt feedback reaches a finite asymptotic value, whereas that of an adiabatic reactor first rises, then drops off. However, for the same initial conditions, the maximum flux attained in an adiabatic reactor is several fold higher than that of a reactor with Newtonian or prompt feedback. (auth)

2538 THEORY OF THIRD-ORDER CORRELATION FUNCTIONS IN SUBCRITICAL ASSEMBLIES. Leginegg, E.; Thury, W. (Technische Hochschule, Graz, Austria). Acta Phys. Austr.; 38: No. 1, 1-12(Aug 1973). (In German).

The third order correlation functions for neutron chains were calculated on the basis of a general method which permits nth order statistical moments to be expressed as a function of given Green functions without explicit use of a neutron field theory. This is applied to the evaluation of the point reactor model in which the Green two-point functions derived can be expressed by modified second order statistical moments. (tr-auth)

2539 REFINEMENT OF NEUTRON-PHYSICAL PARAMETERS FOR AQUEOUS SOLUTIONS OF HIGHLY ENRICHED URANYL FLUORIDE AND URANYL NITRATE SALTS CONSISTENT WITH THE DATA OF CRITICAL EXPERIMENTS. Vasil'ev, Yu. Yu.; Gurin, V. N.; Ryazanov, B. G. Sov. J. At. Energy (Engl. Transl.); 36: No. 2, 165-166(Feb 1974).

Translated from At. Energ. (USSR); 36: No. 2, 136(Feb 1974).

The material parameter and the extrapolation distance are calculated from the system of three-group, macroscopic constants fitted by the method of least squares which best describes the results of one-region critical experiments for a given reactor composition. The application of this method allows one to estimate the errors in predicting the material parameter and the extrapolation distance as a function of the accuracy of the original constants and the critical experiments. Aqueous solutions of uranyl fluoride UO_2F_2 and uranyl nitrate $UO_2(NO_3)_2$ (the uranium enrichment is 93.5 and 90%, respectively) are investigated. Critical experiments in assemblies in the form of a sphere, cylinder, and parallelepiped are analyzed. The calculation is conducted in the three-group diffusion approximation. The more accurate values of the material parameter, the extrapolation distance, the multiplication constant for neutrons in an infinite medium, and the migration area, together with the errors in their prediction, are presented in the form of curves as a function of the uranium concentration in the solution. (auth)

2540 MAXIMUM OF NEUTRON FLUX IN A REFLECTOR WHEN MODERATED NEUTRON ABSORPTION IS TAKEN INTO ACCOUNT. Glushakov, V. P. Sov. J. At. Energy (Engl. Transl.); 36: No. 2, 161(Feb 1974).

Translated from At. Energ. (USSR); 36: No. 2, 133(Feb 1974).

A solution is found for the radial distribution of fuel in a reactor in which the ratio of the maximum thermal neutron density in the reflector to the reactor power is maximized. The problem is solved in the two group approximation, taking into account the absorption of moderated neutrons. (DG)

2541 MOMENTS OF THE MODERATION FUNCTION AND ITS FEW-GROUP MODELS FOR WATER-METAL MIXTURES. Garusov, E. A.; Petrov, Yu. V. Sov. J. At. Energy (Engl. Transl.); 36: No. 2, 178-180(Feb 1974).

Translated from At. Energy. (USSR); 36: No. 2, 143-144(Feb 1974).

The application of the diffusion approximation to the description of slowing-down of neutrons in water-metal reactor core mixtures is discussed. The dependence of fission neutron age (for neutrons slowed to 1.44 eV) and moments of the moderation function on metal/water volume fraction is investigated for mixtures containing aluminum, zirconium, and iron. (DG)

2542 REALITY OF THE EIGENVALUES OF REACTOR BOUNDARY VALUE PROBLEMS IN THE MULTIGROUP DIFFUSION APPROXIMATION. Abramov, B. D. Sov. J. At. Energy (Engl. Transl.); 36: No. 2, 176-177(Feb 1974).

Translated from At. Energ. (USSR); 36: No. 2, 142(Feb 1974).

Eigenvalues and eigenfunctions are sometimes calculated numerically by algorithms based on the assumption that the eigenvalues being calculated are simple and real. It is shown that such an assumption is not always valid, so that a further development of algorithms for calculating further complex conjugate and multiple eigenvalues becomes necessary. An example of a special kind of boundary value problem, some of whose eigenvalues can be complex and multiple, is presented. (auth)

2543 SOME CHARACTERISTICS OF OPTIMAL TRANSIENT PROCESSES WITH A CONSTRAINT ON THE RATE OF VARIATION OF REACTOR POWER. Zaritskaya, T. S.; Rudik, A. P. Sov. J. At. Energy (Engl. Transl.); 36: No. 2, 174-175(Feb 1974).

Translated from At. Energ. (USSR); 36: No. 2, 140-141(Feb 1974).

Xenon and samarium transient processes are investigated with constraints on the rate of variation of reactor power taken into account. It is shown that in optimization problems with these constraints, a seven-stage control is optimal. Promethium-samarium concentration phase plane trajectory diagrams are used to illustrate optimal trajectories of transient processes under various constraint conditions. (DG)

Reactor Components and Accessories

Refer also to abstracts 475, 476, 1108, 1164, and 2521.

2544 (AED-CONF-73-223-013) CONTROL ELEMENTS FOR HEAVY-DUTY USE IN CHEMICAL, NUCLEAR ENGINEERING, AND POWER PLANTS. von Nordheim, G. 1973. 2p. (CONF-730698-8).

From European meeting on chemical engineering and ACHEMA congress; Frankfurt am Main, F. R. Germany (20 Jun 1973).

The role of control elements in chemical and power plants is discussed. The effect of long-term availability and reliability requirements and operating conditions on design specifications is examined. (DG)

2545 (DAfStb-1) REPORTS ON THE RESEARCH PROJECTS "PRESTRESSED CONCRETE REACTOR PRESSURE VESSELS" SPONSORED BY THE BUNDESMINISTERIUM FUER BILDUNG UND WISSENSCHAFT. Bunke, N. (Deutscher Ausschuss fuer Stahlbeton, Berlin (F. R. Germany)). 1972. vp. (In German).

The present state of development and the results of individual projects are described, and a summary of the planned program is given. Investigations carried out in the following topics are reported: material properties, theoretical work for calculations, measurement and construction of prestressed concrete vessels, vessel components (liner, heat shield system, lids, etc), development optimization of the design, cost analysis, and instrumentation. (GE)

2546 (DEU-72-15) STATE AND ENGINEERING OF THE METHODS OF DRY CLOSED-CIRCUIT COOLING AS WELL AS ITS ECONOMIC PROSPECTS. Wolf, H. (Battelle-Institut e.V., Frankfurt am Main (F. R. Germany). Abt. Verfahrenstechnik). Nov 1971. 123p. (In German).

A technical and economical analysis of the present state of processing techniques and air-cooling systems (dry cooling) in the field of power production is presented. The analysis results in starting points for development work and helps to decide on the question of public promotion of this field. (GE)

2547 TUBE BUNDLE ASSEMBLY. Pettigrew, M. J. (to Atomic Energy of Canada Ltd.). US Patent 3,837,397. 24 Sep 1974. Filed Date 14 Feb 1972. 4p.

A description is given of a tube bundle assembly (a heat exchanger tube bundle or a nuclear fuel element tube bundle) which comprises a bundle of laterally spaced tubes, a frame around the outermost tubes, and a lattice of wire cables with their ends held against lateral displacement by the frame and the tubes in the lattice interstices. The cables are deflected round a portion of each tube to space the tubes from one another, and the cables are preferably tensioned against the frame for this purpose. (Official Gazette)

2548 WEIGHTS AND OUTER VOLUMES OF THICK-WALLED CYLINDRICAL AND SPHERICAL PRESSURE VESSELS. Arbel, A. (University of the Negev, Beersheba (Israel)). Nucl. Eng. Des.; 30: No. 1, 97-99(Jul 1974).

Weights and outer volumes of cylindrical and spherical thick-walled pressure vessels which contain a given amount of gas are considered. Decrease of vessel weight demands an increase in inner diameter. The outer diameter of pressure vessels can be minimized when the internal pressure obtains an optimal value. (auth)

2549 EXPERIMENTAL DETERMINATION OF PHYSICAL PARAMETERS: CONDITION WHEN PARAMETERS CANNOT BE UNIQUELY ESTIMATED. Beck, J. V. (Michigan State Univ., East Lansing (USA). Div. of Engineering Research). Nucl. Eng. Des.; 30: No. 1, 134-143(Jul 1974).

In nuclear engineering a recurring problem is the estimation of parameters from measurements. A basic method of determining these parameters is called parameter estimation or nonlinear

least squares. There are cases when only a limited number of parameters of those desired can be estimated from the data. The identifiability problem is an investigation of condition(s) when the parameters can and cannot be estimated. For both linear and nonlinear problems it is shown that a group of parameters cannot all be simultaneously estimated if the associated sensitivity coefficients are linearly dependent in the region surrounding the true values of the parameters. Several examples are given. (auth)

2550 SOLID-BORNE SOUND MEASURING — A MEANS OF OPERATIONAL MONITORING OF REACTOR PRESSURE VESSELS. Moravek, I.; Raible, B. (Allianz-Zentrum fuer Technik G.m.b.H. (AZT), Ismaning/Muenchen (F. R. Germany). Arbeitsgruppe Messtechnik). pp 19-24 of Nuclear Power Stations – Technology and Insurance. 7th Allianz Technical Colloquium on the 4th December, 1973 in Munich. Muenchen, F. R. Germany; Allianz(1974). (In German).

From 7th Allianz technical colloquium; Muenchen, F. R. Germany (4 Dec 1973). 9 figs. With abstract in German, French and English.

Solid-borne noises in reactor pressure vessels can be divided into three frequency ranges: in the low frequency range below 100 Hz, pendulum motions of the core shell are ascertainable and vibrations of other components can be observed: in the medium frequency peaks of the pumps are identifiable; and in the upper frequency range, up to the limit frequency of the accelerometer, knocking and ringing noises of loose and loosened parts can be found. The locating of loosened parts is rendered possible by means of delay measuring. Solid-borne sound measuring can be applied in these cases as diagnosis procedure. The sound locating procedure must, however, be made the subject of further investigation and testing, whereby new problems may possibly arise. (auth)

2551 AN AXISYMMETRIC RECTANGULAR ELEMENT USED IN THE STRESS ANALYSIS AND HEAT CONDUCTION PROBLEM. Akasoy, S. (Technische Univ. Darmstadt (F. R. Germany)). Nucl. Eng. Des.; 30: No. 1, 62-72(Jul 1974).

The application of an axisymmetric element of rectangular cross section (AXSHER) to stress analysis and the steady-state heat conduction problem is considered. The shape functions are continuous at the inter-element boundaries up to the first derivatives. Several examples are presented to demonstrate the efficiency of the element for both thick and thin axisymmetric structures. The comparison between the results of different axisymmetric elements and the exact results confirms the accuracy and convergence of the element. Economic limitation in data preparation and computing time is achieved by the formulation used. (auth)

2552 THERMAL STRESSES AROUND CIRCULAR HOLES IN SPHERICAL SHELLS. Prakash, P.; Rao, K. P. (Indian Inst. of Science, Bangalore). Nucl. Eng. Des.; 30: No. 1, 83-87(Jul 1974).

The thermal stress problem of a circular hole in a spherical shell of uniform thickness is solved by using a continuum approach. The influence of the hole is assumed to be confined to a small region around the opening. The thermal stress problem is converted as usual to an equivalent boundary value problem with forces specified around the cutout. The stresses and displacement are obtained for a linear variation of temperature across the thickness of the shell and presented in graphical form for ready use. (auth)

2553 METHODS OF PREVENTING THE BRITTLE RUPTURE OF REACTOR VESSEL STEELS. Petrequin, P.; Gauthier, J. P. (CEN de Saclay, Gif-sur-Yvette, France). Bull. Inform. Sci. Tech. (Paris); No. 192, 51-62(May 1974). (In French).

Methods used to prevent the violent rupture of containers under pressure are outlined: use of resilience, use of Pellini's fracture analysis diagram (FAD), and rupture mechanics. Methods based on the mechanics of elastic linear rupture are developed in more detail. The case of embrittlement of materials in service is examined, with special reference to irradiation effects. (FR)

2554 STRUCTURAL AND CONSTRUCTIONAL PROBLEMS IN PRESTRESSED CONCRETE REACTOR PRESSURE VESSELS. Zerna, W.; Schnellenbach, G.; Wrage, S. (Bochum Univ. (F. R. Germany)). Nucl. Eng. Des.; 27: No. 3, 343-358(Jul 1974). (In German).

The voluminous dimensions and high demands on the quality of prestressed concrete pressure vessels raise the questions of specifying the optimum concrete quality and of the concreting units to important aspects. The orderly placement and compaction of concrete underneath the almost horizontal base of the liner leads to special technical difficulties. Some solutions pertaining to these problems are discussed. Improvements in circumferential prestressing techniques are presented. Special problems of structural layout arise in the transition regions between the cylindrical wall and the end slabs at the inside of the vessel. Placement of different components and reinforcement in such a way that their installation remains practicable and such that proper compaction of concrete in these zones can be assured is a difficult task. The difficulties could be considerably reduced by using concrete reinforced with steel micro-reinforcement. The advantages of this new material for the construction of entire PCPVs are discussed. Different structural design possibilities and their respective design criteria are discussed. Their advantages and disadvantages are pointed out. (auth)

2555 EARTHQUAKE INSTRUMENTATION FOR NUCLEAR FACILITIES. Pauly, S. E. (Kinemetrics Inc., Eastern Office, 511 Synder Ave., Berkeley Heights, New Jersey, USA). Nucl. Eng. Des.; 27: No. 3, 359-371(Jul 1974).

Regulatory and industry guidelines have been developed in the US for earthquake instrumentation so that factual site and structural response records will be made during earthquakes. These guides have resulted in the development of specialized sensor, recorder and display units which can meet the functional and environmental specifications. Prompt operator access to the recorded data is important, so that both unsafe continued plant operation and unwarranted shutdown can be avoided. The strong motion accelerograph is the basic and principal instrument for this application. This system records acceleration time histories of response for remotely located triaxial sensor units. Additional instrumentation including peak recording accelerographs and response spectrum recorders are used to augment the basic system. Detailed analyses will be carried out after a significant earthquake using mathematical models and the recorded structural response data. The validity of the models must be verified before confidence can be placed in the calculated results. Experimental testing techniques for the full-scale structure which are useful in the model validation process are described. (auth)

2556 COMBINED ANALYSIS AND EVALUATION OF PIPING SYSTEMS USING THE COMPUTER. Watwood, V. B.; Chow, T. Y.; Zudans, Z.; Miller, W. H. (Franklin Inst. Research Labs., Philadelphia, Pa. (USA)); Ortner, M. (SDK Ingenieurunternehmen fuer Spezielle Statik, Dynamik und Konstruktion, Loerrach (F. R. Germany)). Nucl. Eng. Des.; 27: No. 3, 334-342(Jul 1974).

The organization and theoretical aspects of a computer program designed primarily for the analysis and evaluation of power piping with particular emphasis on nuclear class I and II piping are described. The program includes a one-dimensional (radial coordinate in a cylindrical system) thermal analysis. Six types of loadings may be considered simultaneously: deadweight, sustained design mechanical loads, thermal expansion, thermal anchor movement, earthquake-response spectra or time history, and other anchor movement. For dynamic analysis the generalized Rayleigh-Ritz method using unit loads to generate the trial vectors is utilized. This method provides a consistent reduction of both the stiffness matrix and the mass matrix. A method is described for checking the trial vectors for their degree of parallelism in kinetic energy space, and for automatically removing those degrees of freedom which may lead to difficulties. Sample solutions with the program are presented. (auth)

2557 APPLICATION OF STATISTICAL LINEAR ELASTIC FRACTURE MECHANICS TO PRESSURE VESSEL RELIABILITY ANALYSIS. Becher, P. E.; Pedersen, A. (Danish Atomic Energy Commission, Risoe. Research Establishment). Nucl. Eng. Des.; 27: No. 3, 413-425(Jul 1974).

An evaluation of the failure probability for a pressure vessel is made on the basis of linear elastic fracture mechanics (LEFM). Failure is identified by actual crack length equal to critical crack length. The integrated calculations of failure probability are performed by a computer program utilizing the Monte Carlo technique with importance sampling, which gives a greater freedom in selection of probability density functions. Calculations of failure probability for existing reactors are presented. (auth)

2558 ON THE STRUCTURAL RELIABILITY OF REACTOR SAFETY CONTAINMENTS. Schueller, G. I. (Technische Univ. Muenchen (F. R. Germany)). Nucl. Eng. Des.; 27: No. 3, 426-433(Jul 1974).

A method for reliability based design of reactor safety containments is suggested, and a brief review of classical reliability analysis is presented. Seismic and climatic load occurrences are modeled by uniform Poisson processes. Extreme value distributions are assumed to represent the seismic, climatic, external and internal pressure load intensities. Reliabilities are calculated for various design loads and load combinations. (auth)

Reactor Fuels

Refer also to abstracts 1064, 1065, 1070, 1117, 1134, and 1159.

2559 (AED-CONF-73-223-023) INDUSTRIAL PROCESS ENGINEERING ASPECTS OF THE INDUSTRIES ASSOCIATED WITH THE NUCLEAR FUEL CYCLE. Wirths, G. (Nuklear-Chemie und -Metallurgie G.m.b.H. (NUKEM), Grossauheim (F. R. Germany)). 1973. 18p. (In German). (CONF-730698-13).

From European meeting on chemical engineering and ACHEMA congress; Frankfurt am Main, F. R. Germany (20 Jun 1973).

An introduction into the fundamentals of nuclear fission is followed by a description of the individual steps of the nuclear fuel cycle, discussing in particular industrial nuclear fuel fabrication. (GE)

2560 (WCAP-4167-6) EEI-WESTINGHOUSE PLUTONIUM RECYCLE DEMONSTRATION PROGRAM. Progress Report, April-September 1973. Wallace, T. W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Nuclear Fuel Div.). Dec 1973. Contract AT(30-1)-4167. 35p. Dep. NTIS $4.75.

The operational performance of demonstration plutonium fuel assemblies in the San Onofre reactor is described. The results of examinations of demonstration assemblies and selected fuel rods during the end-of-cycle 3 shutdown are reported. Plans for hot cell examinations of selected fuel rods from cycles 2 and 3 are discussed. (JWR)

2561 NUCLEAR REACTOR FUEL ELEMENT GRID. Chetter, J. (to United Kingdom Atomic Energy Authority). US Patent 3,833,471. 3 Sep 1974. Priority Date 7 Jul 1971, United Kingdom of Great Britain and Northern Ireland. 6p.

A spacer grid is described which comprises a grid structure formed from intersecting strip members defining cells which are penetrated by fuel pins bearing against rigid stops projecting inside the cells and spring locating members in the form of bow springs which extend longitudinally in the cells of the grid structure to hold the fuel pins against the rigid stops in the cells, the bow spring members of each line of cells extending in one direction across the grid structure having their corresponding ends interconnected by common longitudinal bridging strips to form a ladder spring assembly. (Official Gazette)

2562 A NORMALLY PERMISSIBLE METHOD OF SIMPLIFYING, WITHOUT ANY LOSS IN ACCURACY, THE WALTHER MODEL FOR CALCULATING THE MECHANICAL PERFORMANCE OF COATED FUEL PARTICLES. Martin, D. G. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Nucl. Eng. Des.; 30: No. 1, 73-82(Jul 1974).

The Walther formalism may be simplified if the properties of each layer in a coated fuel particle are such that the expressions $[_{33}C^k_{\alpha,i} + {}_{13}C^k_{\alpha,i}]/[_{11}C^k_{\alpha,i} + {}_{12}C^k_{\alpha,i}]$ and $[_{33}C^k_{T\alpha,i} + {}_{13}C^k_{T\alpha,i}]/[_{11}C^k_{T\alpha,i} + {}_{12}C^k_{T\alpha,i}]$ are equal and independent of neutron dose. The symbols $C_{\alpha,i}$ and $C_{T\alpha,i}$ denote the elastic and radiation creep constants of layer i, the superscript (k) indicates that these are in general functions of neutron dose, while the subscripts 1 and 2 refer to the tangential and 3 to the radial directions. Provided these conditions are valid (as they are for most, if not all model calculations performed to date) the need to compute stresses at closely spaced intervals across each layer and perform a number of numerical integrations are eliminated. Since these particular parts of the associated computer program STRESS 3 are by far the most time consuming, a significant saving in computation time may be achieved. (auth)

Reactor Control Systems

2563 (DEU-72-14) RESEARCH INTENTIONS CONCERNING THE ADVANCED INSTRUMENTATION OF NUCLEAR REACTORS AND THE DYNAMICS AND STABILITY OF LARGE POWER REACTORS WITH REGARD TO SAFETY. Annual Report 1970. (Technische Univ. Muenchen (F. R. Germany). Inst. fuer Mess- und Regelungstechnik). 1970. 47p. (In German).

Results of research in the following areas are reported: (1) determination of reactor operating behavior by means of an analysis of stochastic and determining variations of process values, (2) investigation of the dynamic behavior of nuclear reactor plants, (3) investigations of the static behavior of nuclear reactors and criticality investigations, (4) investigation of the dynamic behavior of nuclear reactor plants under disturbance conditions, (5) investigation of the reliability of reactor components, (6) studies of the requirements of process computers in nuclear power plants, (7) special investigations concerning reactor safety, and (8) structure, operation and soft-ware development of the hybrid computer. A list of reports, publications and lectures given during the year is added. (GE)

2564 (GEAP-14017) EVALUATION OF THE FIRST-ORDER POWER DISTRIBUTION AND CONTROL WORTH INFLUENCE FUNCTION APPROACH. Cowan, C. L.; Derby, S. L. (General Electric Co., Sunnyvale, Calif. (USA). Advanced Technology Dept.). Jul 1974. Contract AT(04-3)-893. 57p. AT.

Approximate methods for predicting the three-dimensional effects of control rod movements are needed for rapid fuel management computations and for the on-site calculation and planning of LMFBR operations. On the basis of these requirements a first-order influence function approach for predicting power distributions and control reactivity worths has been formulated. Extensive testing of the influence function approach has been carried out for a wide range of control distribution patterns in the ZPPR-3 and ZPPR-4 critical assemblies. Comparisons of the three-dimensional influence function synthesis and direct calculations indicate that the pointwise power distribution and control worth can be predicted to within an accuracy of four percent for control patterns which are typical of an LMFBR operating cycle. Second-order corrections which account for control rod interactions can further reduce this uncertainty, if necessary. Based upon the results of the testing program, it is concluded that the influence function approach is a simple, rapid and effective technique for carrying out three-dimensional calculations of the effects of control rod movements in a specified LMFBR system. 8 references. (auth)

2565 RELIABILITY ANALYSIS OF ELECTRONIC MODULES WITH DIGITAL INPUTS. Nieckau, E. (Laboratorium fuer Reaktorregelung und Anlagensicherung, Garching, Reaktorstation, Germany). Nucl. Eng. Des.; 30: No. 1, 117-122(Jul 1974).

Electronic modules which are simultaneously triggered by several digital inputs are used, for example, in protection systems of nuclear power plants for actuating positioning devices. As these control chains are not constructed self-checking, like most other parts, they substantially influence the reliability of the whole system. It becomes apparent that failure modes and failure rates of such control chains can be determined best by means of the fault tree method. As the set-up of fault trees is rather time-consuming, this task is best fulfilled by a digital computer. The mode of operation of the program and the course and results of a reliability analysis are explained by the examination of a control chain for the actuation of a positioning driver. (auth)

2566 PROBLEMS IN CONNECTION WITH REPAIRS TO THE CONTROL ROD APERTURES OF THE REACTOR PRESSURE VESSEL IN THE VAK. Ellmer, M. (Versuchsatomkraftwerk G.m.b.H., Kahl/Main (F. R. Germany)); Kison, H. (Kraftwerk Union A.G., Frankfurt am Main (F. R. Germany)). pp 44-48 of Nuclear Power Stations - Technology and Insurance. 7th Allianz Technical Colloquium on the 4th December 1973 in Munich. Muenchen, F. R. Germany; Allianz(1974). (In German).

From 7th Allianz technical colloquium; Muenchen, F. R. Germany (4 Dec 1973). 7 figs. With abstract in German, English and French.

The authors make reference to an occurrence of damage in the VAK, which led to a shutdown on the 27th December, 1971. The problems which arose during the subsequent repairs are described. It was thereby revealed that the retro-interplay of the experience parameters between design, manufacture and operation merits particular attention and must in future be further improved. Here, the damage research sector in particular is approached to ensure an improvement in the flow of experience with the aim of eliminating known causes of damage in new stations. (auth)

Nuclear Power Plant Economics

2567 (DEU-73-12) FURTHER CONSTRUCTION AND THE USE OF NUCLEAR POWER PLANTS IN NORTHRHINE-WESTPHALIA BASED ON ECONOMIC OPTIMIZATION ANALYSES FOR A MEDIUM-TERM PLANNING PERIOD OF ABOUT 10 YEARS. Bieselt, R. (ed.). (Technische Hochschule Aachen (F. R. Germany). Inst. fuer Elektrische Anlagen und Energiewirtschaft). Jun 1972. 98p. (In German).

The development of a method to determine the optimum utilization and further extension of a power plant network are discussed. The method is based on an optimization procedure by dynamic programming. The objective is to find the optimum solution with regard to the utilization of currently available power plants and the further construction of new ones in order to guarantee minimum total net generation costs within a medium-term planning period of about 10 years. The practical application of this method is illustrated by using Northrhine-Westphalia as an example. In order to find an optimum solution for the supply of a large area,

the various supply districts are considered as a whole. The evaluation of the results shows that the further construction of units larger than those presently available is one of the conditions of an optimal solution in terms of economics, as it is demonstrated that new nuclear power plants with a unit capacity of 1,200 MW are undoubtedly more efficient than 600 MW units. The same applies to the conventional power plants considered, as it can be seen that the 600 MW units are to be preferred to the smaller 300 MW units for base-load and medium-load operation. (GE)

2568 (N-74-23481) COMPARATIVE EVALUATION OF SOLAR, FISSION, FUSION, AND FOSSIL ENERGY RESOURCES. Part 2. Power from Nuclear Fission. Final Report. Clement, J. D. (Georgia Inst. of Tech., Atlanta (USA). School of Nuclear Engineering). 1973. 82p. (NASA-CR-138397; E-26-606(Pt. 2)). NTIS $7.25.

Different types of nuclear fission reactors and fissionable materials are compared. Special emphasis is placed upon the environmental impact of such reactors. Graphs and charts comparing reactor facilities in the U. S. are presented. (STAR)

2569 THERMODYNAMIC CONSIDERATION OF THE PRODUCTION OF ELECTRIC POWER IN THE NETHERLANDS IN THE FUTURE. van Lier, J. J. C. (Technische Hogeschool, Delft, Netherlands). Elektrotechniek; 52: No. 7, 406-428(1974). (In Dutch).

The state of the art and the probability of application in the Netherlands of various methods by which electric power can be generated are discussed on the basis of thermodynamic aspects. A comparative evaluation of nuclear power generation and other methods is given. Special attention is paid to the use of hydrogen as intermediary energy source. (NL)

2570 CZECHOSLOVAK–SOVIET COOPERATION IN NUCLEAR POWER. Neuman, J. (Czechoslovak Atomic Energy Commission, Prague). Veda Tech. SSSR; 1: No. 3, 1-3(Jun 1973). (In Czech).

Czechoslovak-Soviet cooperation in the field of nuclear power has developed in three stages—from Soviet aid in establishing nuclear research in Czechoslovakia to the present stage of the integration of research, development, and production in the field of nuclear power production and nuclear power engineering. (Nuclear Sci. Abstr. Czech.)

Reactor Fuel Cycle Economics

2571 NUCLEAR FUEL COST EVALUATION CODE. Hamada, M.; Arai, H. (Electric Power Development Co. Ltd., Tokyo). Dengen Kaihatsu K. K., Chosa Shiryo; No. 51, 86-112(Mar 1973). (In Japanese).

The COBRA-TWIST code has been developed for the calculation of fuel cycle cost in nuclear power plants. Some features and the calculational models used are presented. A general introduction to nuclear fuel cycle is given. Starting from the mining of uranium ore, various aspects of the nuclear fuel cycle such as refinement, conversion, enrichment, fabrication of fuel assemblies, usage in reactors, cooling, reprocessing and transportation are explained. Basic principles adopted in the code are presented. The accounting principle of the code is based on the accounting rule established by the Japanese Association of Electric Power Industry. One of the main features of the rule is that the reduction of fuel cost due to fuel depletion should be evaluated by multiplying initial cost of the fuel to the ratio of present (in the period of cost evaluation) burnup to designed total burnup. Cost evaluation is performed annually for each batch of fuel assemblies. A flow chart for the code, the calculational models, and equations used are explained in detail. Input data and output items are also presented. As an example, the results of calculations performed for reactors of a given type are summarized, in which the continuous refuelling method and the batch refuelling method are compared from economical bases. Lists of typical input data and output items are also presented. (JA)

Reactor Licensing and Regulation

2572 (DOCKET-50219-580) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Semiannual Operating Report No. 10, January–June 1974. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 29 Aug 1974. 104p. Dep. NTIS $8.25.

During this period, the plant operated with an availability factor of 50.33% and a capability factor of 47.32%. There were three shutdowns for drywell snubber inspection and maintenance, repairs to torus to drywell vacuum breakers, and the annual refueling/maintenance outage. There were seven load reductions, the most significant resulted in an approximate 4% loss in generation from March 20th to the start of the refueling/maintenance outage. Power level changes to minimize fuel failures induced by pellet-clad interaction were followed. The reactor was critical for 2,185.90 hours generating 1,325,180 MHh(e). Operations, maintenance, radwaste, environmental, chemistry, and personnel radiation exposures are summarized. Information is presented concerning facility changes, tests, and experiments. (FS)

2573 (DOCKET-50289-282) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Semiannual Operation Report, June 5, 1974 (Initial Criticality) to June 30, 1974. (Metropolitan Edison Co., Reading, Pa. (USA)). 29 Aug 1974. 26p. Dep. NTIS $4.50.

Initial criticality was reached on June 5, 1974. Reactor operations are summarized including facility design changes, procedure changes, and results of tests and inspections. The majority of the shutdowns were for maintenance of safety related systems and components to reduce or prevent the release of radioactive materials. Information is also presented concerning safety evaluations of changes, primary coolant chemistry, occupational personnel radiation exposures, and environmental monitoring. (FS)

2574 (DOCKET-50524-1) ALAN R. BARTON NUCLEAR PLANT, UNITS 1, 2, 3, AND 4. License Application. (Alabama Power Co., Birmingham (USA)). 26 Sep 1974. 93p. (DOCKET-50525-1; DOCKET-50526-1; DOCKET-50527-1). Dep. NTIS $7.75.

An application for a nuclear generating plant with a net installed capacity of 4816 MW(e) consisting of four generating units utilizing boiling water reactors is presented. Each reactor will have a total initial output of 3583 MW(t) with a corresponding gross electric output of 1204 MW(e). Each turbine-generator is expected to have a maximum gross capability of 1209 MW(e) which will correspond to a reactor output of 3758 MW(t) plus 4 MW(t) from non-reactor sources. The plant will be located in central Alabama approximately 15 miles southeast of Clanton along the west side of the Coosa River in Chilton and Elmore Counties. (FS)

2575 (FIND-50448-81) FIND: DOUGLAS POINT NUCLEAR GENERATING STATION, UNITS 1 AND 2. Williams, W. H. (ed.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Oct 1974. 25p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report. (DG)

2576 (FIND-50466) FIND: ALLENS CREEK NUCLEAR GENERATING STATION, UNITS 1 AND 2. Items 1-61. Williams, W. (ed.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Oct 1974. 45p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report. (DG)

2577 (PRDI-74-11) TITLE LISTING OF POWER REACTOR DOCKET INFORMATION. (USAEC Technical Information Center, Oak Ridge, Tenn.). Nov 1974. 66p. TIC $1.45.

Citations and subject indexing to the documentation associated with civilian nuclear power plants are presented. This material is that which is submitted to the Atomic Energy Commission in support of applications for construction and operating licenses. Citations are listed by Docket number in accession number sequence. The Table of Contents is arranged both by Docket number and by nuclear power plant name. (DCC)

GENERAL AND MISCELLANEOUS

Civilian Defense

2578 (AD-779340) EVALUATION OF THE NUCLEAR FIRE THREAT TO URBAN AREAS. Annual Report, August 1972–September 1973. Wiersma, S. J.; Martin, S. B. (Stanford Research Inst., Menlo Park, Calif. (USA)). Sep 1973. Contract DAHC20-70-C-0219. 49p. (SRI-P-4U-8150). NTIS $9.75.

The nuclear fire threat to urban areas was evaluated in a four-task program. An attempt was made to integrate the present structural fire behavior knowledge with blast knowledge and to predict the combined blast-fire responses of an urban area to a nuclear attack. The structural response to blast waves, fire spread in debris, simulating air blast effects, blast-fire interaction, and the influence of air blast were studied. (GRA)

Energy Utilization and Economics

2579 (ANL-8096, pp 143) ENERGY TRANSFER AND ENERGY STORAGE. Apr 1974.

In Chemistry Division annual report, July 1972–June 1973.

A nitrate-iodide cycle is being studied for the production of hydrogen by thermochemical processes. (LK)

2580 (BNL-tr-578) PECULIARITIES OF CORONA DISCHARGE IN LIQUID HELIUM. Goncharov, V. A.; Levitov, V. I. Translated by S. J. Amoretty from Izv. Akad. Nauk SSSR, Energ. Transp.; 10: No. 2, 145-148(1974). 12p. Dep. NTIS $4.00.

The corona discharge in liquid helium occurring at point electrodes with radius of 0.01 to 1.0 mm and electrode separation of 6 to 45 mm was experimentally studied. The V-I characteristics of the corona discharge are presented. The critical and inception corona voltages and the extinction voltages were measured. The characteristic voltages (onset, critical, and extinction) were compared for a positive and a negative corona. The mobilities of the electric charge carriers in liquid helium were determined from the corona V-I characteristics. (auth)

2581 (ORNL-TM-4622) CRYOGENIC POWER TRANSMISSION TECHNOLOGY: CRYOGENIC DIELECTRICS. Quarterly Report, January–March 31, 1974. (Oak Ridge National Lab., Tenn. (USA)). Jul 1974. Contract W-7405-eng-26. 32p. Dep. NTIS $4.75.

During the present quarter several modifications were made to the intermediate voltage equipment to improve performance and quality of the data. The modifications included improved electrode gap stability, electrode surface conditions and exterior flashover performance, a switch to change the polarity of the electrodes, the fitting of probability distribution functions to the breakdown data, work on the high voltage cryostat, and ac breakdown tests with the intermediate voltage cryostat. To verify that modification of the intermediate voltage cryostat had no deleterious effect on the measured breakdown voltages in liquid helium, an additional set of measurements was made with the spherical high voltage electrode positive. The average breakdown voltages agreed well within scatter with the previous ones, but were systematically somewhat higher. Another set of measurements made with opposite polarity also agreed well. At several gaps with both polarities, 120 breakdowns were taken for statistical analysis. Probability plotting techniques were used to determine the type of distribution function which gave the best fit to the data. A report on these investigations is given in Appendix A. (auth)

2582 (SAND-74-0208) SOLAR TOTAL ENERGY PROGRAM. Quarterly Report, April–June 1974. Leonard, J. A.; Thunborg, S. (Sandia Labs., Albuquerque, N. Mex. (USA)). Sep 1974. Contract AT(29-1)-789. 40p. Dep. NTIS $5.00.

This quarterly report describes the activities within Sandia Laboratories Solar Total Energy Program during the final quarter of fiscal year 1974. Included are descriptions of the program's background, overall program plan, and the baseline design of the Solar Total Energy System. (auth)

2583 (TID-3349) COAL PROCESSING: GASIFICATION, LIQUEFACTION, DESULFURIZATION. A Bibliography, 1930–1974. (USAEC Technical Information Center, Oak Ridge, Tenn.). Oct 1974. 763p. Dep. NTIS $13.60.

The bibliography contains references to 7441 publications covering the period 1930 (and earlier) to 1974. The subject areas covered are coal and coal product carbonization, gasification, liquefaction, hydrogenation, purification, desulfurization, pyrolysis, cracking, and solvent extraction. Personal author, subject, and report number indexes are included, as well as a glossary of the more important named processes for converting and purifying coal and coal products. (SFL)

2584 (UCID-16528) USE OF METHANOL IN TRANSPORTATION. Crothers, W. T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Jul 1974. Contract W-7405-eng-48. 37p. Dep. NTIS $5.00.

The methanol process has the highest efficiency in converting coal to a liquid fuel and an energy recovery factor between 50 and 55 percent. Other fuels, such as synthetic gasoline result in about 20 percent additional loss and have an energy recovery factor between 40 and 45 percent. Technology for the conversion to this clean fuel is a proven chemical processing technique. Other coal liquefaction methods are in the pilot plant stages. Methanol and gasoline performance in various engines is compared. Methanol is about as hazardous as gasoline and similar in other respects. It can be blended with gasoline and has the potential of less emissions than gasoline. With slight engine modifications, it will perform well in gasoline-powered vehicles. (auth)

2585 (UCID-16587) THERMODYNAMIC PROPERTIES OF WYOMING COALS. Technical Note 72-18. Krikorian, O. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Apr 1972. Contract W-7405-eng-48. 9p. Dep. NTIS $4.00.

Thermodynamic data on Wyoming coals are needed to calculate the equilibrium reaction products of coal in coal gasification processes. The data that are needed are basically the room temperature enthalpy of formation, $\Delta H^{\circ}_{f,298}$; the absolute entropy, S°_{298}; and the heat capacity as a function of temperature, $C_p(T)$. Results are presented on the $\Delta H^{\circ}_{f,298}$ of coal based on combustion data, and methods of estimating S°_{298} and C_p (T) are discussed. (SFL)

2586 (UCRL-74820) TECHNICAL COMMENT: ON THE THERMAL DECOMPOSITION OF WATER. Ramsey, W. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Jun 1973. 8p. Dep. NTIS $4.00.

Equilibria was calculated for the reactions involved in the thermochemical cycle proposed by Abraham and Schreiner for the production of hydrogen. The key reaction in their cycle is the oxidation of lithium nitrite by iodine. From the equilibria calculations it was concluded that the key reaction would not proceed very far. (LK)

2587 (WASH-1344) RECOMMENDED RESEARCH PROGRAM IN GEOTHERMAL CHEMISTRY. Lyon, R. N.; Kolstad, G. A. (comps.). (Oak Ridge National Lab., Tenn. (USA); USAEC Division of Physical Research, Washington, D. C.). Oct 1974. 48p. Dep. NTIS $5.45.

The research program is aimed at obtaining fundamental chemical data for geothermal processes. The program covers five general areas: thermodynamic and physical properties of geothermal solutions, minerals, and metals; kinetics of chemical reactions and deposition; collection, evaluation, and dissemination of physical and chemical data; natural systems and rock-water interactions; and theoretical modeling of geothermal systems. (LBS)

2588 COST TARGETS FOR COMMERCIAL BREEDER REACTORS. Palmer, R. S.; Horst, K. M. Pub. Util. Fortn.; 94: No. 2, 17-23(18 Jul 1974).

Results show that, based on the AEC's current estimates of uranium resources, the premium that can be paid for LMFBR's over the capital cost of light water reactors will be in the range of $150/kWe to $250/kWe (1974 dollars) for a reactor ordered in the early 1980's and starting up in 1990. This premium arises primarily from projections of rising uranium ore costs and is larger for later reactor orders. Although actual capital costs for future commercial LMFBR's are uncertain, current estimates indicate that the allowable premiums should ensure the LMFBR's commercial success once the supporting development work is accomplished and first-of-a-kind costs are overcome by the construction of a sequence of commercial LMFBR's. With the LMFBR, valuable domestic uranium resources can be protected and their economic utilization with acceptable environmental effects can be assured. The development of a commercial LMFBR assuring unlimited supply of low-cost energy for future generations is needed. (MCW)

Information Handling

2589 (EDFB-IBP-74-10) NUTIS: NUMERICAL AND TEXTUAL INFORMATION SYSTEM. Version 1.0. A User's Manual. Strand, R. H.; Taylor, D. G. (Oak Ridge National Lab., Tenn. (USA)). Oct 1974. Contract W-7405-eng-26. 27p. Dep. NTIS $4.00.

Ecological research, ranging from the effect of pH, temperature, and light on photosynthetic rate to the changes in behavioral

and reproductive patterns of fish in a polluted lake, is dependent on the analysis and synthesis of as many pertinent parameters of the ecosystem under study as is possible. This requires extensive use of extant data to provide insight into the behavior of parameters that were not directly measured in the system. One objective in the International Biological Program was the development of integrated and automated information handling procedures for numeric data from comprehensive total ecosystem analyses. The design of the Numerical and Textual Information System (NUTIS) was centered on this objective. The NUTIS command Language consists of only four commands– ? PASSWORD, ?SELECT, ?STATUS, AND ?UPDATE. The first command provides access control to the data bank. The second retrieves numeric data from the data-bank files. The third provides a sorted, tabular, textual display of the status of all the data sets in the data bank. The last command creates and maintains the data bank in computer accessible form. (MCW)

2590 (UCC-ND-291) FACTORS INFLUENCING THE TRANSFER OF GOVERNMENT TECHNOLOGY TO THE PRIVATE SECTOR. McMillan, J. R.; Wheeler, D. J.; Koons, M. E.; Read, A. M. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). 11 Oct 1974. Contract W-7405-eng-26. 55p. Dep. NTIS $5.75.

This research is a follow-up to study entitled "An Assessment of Technology Transfer–Industrial Cooperation Bulletins and Supplemental Information," published in March 1974. A mail questionnaire was designed to evaluate the Industrial Cooperation Bulletins and Supplemental Information Packets now utilized by Union Carbide Corporation to disseminate unclassified technology developed for the Atomic Energy Commission by Union Carbide's Nuclear Division. In-depth information was developed about the experiences of firms that had either implement selected AEC-UCCND technologies made available to the public. Of special interest were the 106 technologies that were publicized in the IC Bulletins at the time the study was made. (MCW)

Law

Refer also to abstracts 710, 712, 716, 761, 2242, and 2244.

2591 (TID-26539) INDEXES TO ATOMIC SAFETY AND LICENSING BOARD ISSUANCES THROUGH DECEMBER 1972. (USAEC Technical Information Center, Oak Ridge, Tenn.). Oct 1974. 107p.

Digest and indexes are presented that encompass all significant reactor licensing actions taken by the Atomic Safety and Licensing Board since that Board was created by Public Law 87-615 on August 29, 1962. Full copies of the indexed issuances may be found in AEC Reports, Volumes 1 through 4, and in Commission and Licensing Boards Issuances, TID-26300. The indexes may be approached from five avenues: (1) Case Name, (2) Digests and Headers, (3) Legal Citations; separately as Cases, Regulations, or Statutes; (4) Subject; or (5) Facility Name. This publication should appeal to attorneys, utilities, licensees, intervenors, and contractors. (TSS)

2592 ORDINANCE RELATING TO THE COMPETENCES IN THE FIELD OF THE ATOMIC ENERGY LAW AND THE RADIATION PROTECTION AND THE X-RAY ORDINANCE. Gesetz-Verordnungsbl. Land Hess., Teil 1; No. 7, 137-140(Feb 1974). (In German).

The full text is given of the ordinance of the Land Hesse. (GE)

2593 NUCLEAR ENERGY. pp 1592-1609 of Conditions de Travail. Lois et Textes Reglementaires. Pluyette, J. Paris; Technique et Documentation (1973). (In French).

The convention on civil liabilities in the nuclear energy field, signed in Paris on July 29th 1960, and the additional clauses to this convention signed on January 28th 1964, are the subject of a decree published in the official gazette. (FR)

2594 PUBLIC AND THE PEACEFUL ATOM: PARTICIPATION IN AEC REGULATORY PROCEEDINGS. Jacks, W. T. Tex. Law Rev.; 52: No. 3, 466-525(Mar 1974).

Dangers of the nuclear generating process are discussed, including LOCA, earthquakes, sabotage, radiation releases during routine plant operation, effects on aquatic life, and the AEC and nuclear power plant safety. Licensing procedures include: site selection and preapplication site review, the construction permit stage, Advisory Committee on Reactor Safeguards review, mandatory public hearing, the operating license stage, and generic hearings. The functional theory of intervention, the purposes of AEC hearings, the functions of intervenors, dysfunction intervention, and the proper role of intervenors are discussed. (193 references) (MCG)

Management

Refer also to abstract 2591.

2595 (BNWL-SA-4969) MANAGING GROWTH AND CHANGE IN R AND D ORGANIZATION: THE ROLE OF DYNAMIC MODELING. Addison, L. E.; Litchfield, J. W.; Hansen, J. V. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). [nd]. 9p. (CONF-741022-1). Dep. NTIS $4.00.

From IEEE Systems, man and cybernetics conference; Dallas, Texas, USA (2 Oct 1974).

A systems dynamic model of its R & D organization was developed by Battelle-Northwest to serve as a basis for improved management planning and policy making. This model was designed to be applied in an interactive man-model environment. Thus far, the model has proven useful in forecasting future resource demands under various contingencies; in providing a framework for discussion and analysis of the impact of management policies and decisions; and, importantly, it has improved managements' understanding of the structure and dynamics of their organizational environment. (auth)

2596 (CONF-740831-1) PATHOPHYSIOLOGY AND DIAGNOSIS OF INTERNAL CONTAMINATION. Lincoln, T. A. (Oak Ridge National Lab., Tenn. (USA)). 1974. 20p. Dep. NTIS $4.00.

From health physics society meeting; Fort Walton, Florida, USA (9 Aug 1974).

The management of radiation accidents resulting in internal decontamination is discussed. It is emphasized that preplanning for the management of accidents is essential and that experienced and knowledgeable personnel must be available at all times, at least for telephone consultation, for making initial decisions regarding the care of the patient. The value of the network of regional offices of the AEC Radiological Assistance Program in furnishing information on qualified physicians and health physics specialists in any region is pointed out. The importance of early treatment decisions for the patient and of the early collection of all pertinent information concerning the circumstances of the accident is emphasized. Procedures are outlined for first aid management of the patient and for the later diagnosis of internal contamination. (CH)

2597 (ORNL-4973) PERSONNEL INVOLVED IN THE DEVELOPMENT OF NUCLEAR STANDARDS IN THE UNITED STATES, 1974. Zapp, F. C. (comp. and ed.). (Oak Ridge National Lab., Tenn. (USA)). Sep 1974. 369p. Dep. NTIS $10.60.

The 1974 Edition of the Personnel Directory is an information source for identifying and locating personnel who have expertise in a particular nuclear area or subject, and the ORNL data bank can be utilized as a national information center for personnel involved in the development of voluntary consensus nuclear standards. The Directory format is based on four sections: personal name; company name; standards organizations and committees; and KeyWord-In-Context where titles are permuted around various keywords for all standards organizations, committees, and subcommittees in the Directory. (MCW)

2598 (WASH-1188-74) PHYSICAL RESEARCH PROGRAM: RESEARCH CONTRACTS AND STATISTICAL SUMMARY. (USAEC Division of Physical Research, Washington, D. C.). 1 Jul 1974. 36p. Dep. NTIS $5.00. GPO $1.05.

The AEC-sponsored physical research program consists of theoretical and experimental investigations designed to support the objectives of the AEC's nuclear and nonnuclear energy efforts. Approximately four-fifths of the total physical research program costs are associated with research conducted in AEC-owned, contractor-operated, federally funded research and development centers. A little less than one-fifth of the costs are associated with the support of research conducted in other laboratories. The tables in this volume summarize the level of effort of the physical research program as of the end of Fiscal Year 1974. (RWR)

2599 EFFECTIVENESS OF INTERHOSPITAL RADIOTHERAPY PROGRAMS. Pan, V. Philadelphia; Univ. of Pennsylvania (1974). 299p. University Microfilms Order No. 74-22,889.

Thesis (Ph. D.).

Radiotherapy is a highly specialized service and requires large initial capital investment costs and large operating costs as a result of the need for a staff of specially trained personnel. The widespread duplication of radiotherapy services across the nation has resulted in two adverse effects: duplication raises the cost of care needlessly and duplication among nearly co-located hospitals lowers the quality of care by diluting the clinical experience of some physicians to levels which are below medically accepted levels. The organization of radiotherapy activities and resources among a group of nearly co-located hospitals is anticipated to alleviate the adverse effects of duplication. Five classes of interhospital organizational solutions are proposed. Each of these solutions influences cost and quality of care with different levels of effectiveness. The most effective organizational solu-

tions are the hardest to implement because some practicing physicians interpret these solutions as a threat to their existence. The less effective organizational solutions are easier to implement because they pose less of a threat to these physicians. The formulation and analysis of these five interhospital organizational solutions forces the decisionmaker to consider the acceptability of proposed solutions. Computer based models are used to predict the altered behavior of five Philadelphia hospitals under each of the untried interhospital organizational schemes. Performance measures are defined that permit a decisionmaker to select desirable forms of interhospital organization. Finally, viability measures which describe the acceptability of solutions are used as a basis for implementation. (Diss. Abstr. Int., B)

Mathematics and Computers

2600 (AAEC/E-318) AAEC FACILITIES TO AID IN THE DEVELOPMENT OF FORTRAN PROGRAMS. Johnson, S. G.; Sanger, P. L. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jun 1974. 65p. Dep. NTIS (US Sales Only) $6.25.

Two subroutines, DBGON and DBGOFF, designed to give users more control over the debug options supplied with the IBM 360 FORTRAN IV [G] compiler are described. Examples of the use of these subroutines in the debugging of a FORTRAN program are presented. Macros developed to simulate FORTRAN I/O in Assembler programs are also described, and their value to programmers converting FORTRAN programs into Assembler language routines is demonstrated. (auth)

2601 (AERE-R-7477(Suppl.1)) HARWELL SUBROUTINE LIBRARY. A Catalogue of Subroutines (1973), Supplement No. 1. Hopper, M. J. (comp.). (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Aug 1974. 18p. Dep. NTIS (US Sales Only) $4.00. UK 50 pence.

Subroutines introduced into the Library from August 1973 to July 1974 are DDO3AD, FPO1A, MA19A, OBO1A, PAO6AD, PAO7AD, OGO1A, OGO2A, TCO1A, TGO2A, VEO6A, VFO1A, VGO1A, and VGO2A. (MCW)

2602 (BNWL-SA-5154) ON-LINE AUTOMATIC HIGH SPEED INSPECTION OF CARTRIDGE CASES. Coleman, W. J.; Reich, F. R.; Erickson, M. D.; Kelly, W. S. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1974. 20p. (CONF-741020-2). Dep. NTIS $4.00.

From automated inspection and product control conference; Chicago, Illinois, USA (15 Oct 1974).

A small caliber cartridge case automatic inspection and reject system has undergone initial quality assurance testing. The system gauges case profile, surface flaw, wall thickness, and vent hole presence. A mechanical handling system coupled with computer control and data acquisition automatically inspects and rejects 5.56 mm cases at the rate of 1200 per minute. (MCW)

2603 (CISE-N-167) SOME METHODS FOR NONLINEAR EQUATIONS. Spedicato, E. (Centro Informazioni Studi Esperienze, Milan (Italy)). Mar 1974. 37p. Dep. NTIS (US Sales Only) $5.00.

Many mathematical problems lead to the need for solving systems of nonlinear equations. Some methods are discussed that may solve such a problem even in the case of a large sparse Jacobian, and the corresponding computer programs are given. Their performance on some test problems is also included. (auth)

2604 (CONF-741018--, pp 29-36) USE OF AN AUTOMATED POPULATION DATA BASE IN POPULATION EXPOSURE CALCULATIONS. Athey, T. W.; Tell, R. A.; Janes, D. E. (Environmental Protection Agency, Silver Spring, MD). Oct 1974.

From 8th midyear topical symposium of the Health Physics Society; Knoxville, Tennessee, USA (21 Oct 1974).

In Population exposures.

The assessment of potential hazard to the population from a source in the environment often requires a knowledge of the specific geographic population distribution around the source. A computer program package and data base, developed primarily for marketing purposes in the U. S. Department of Commerce was adapted for use in a number of population exposure problems in the ionizing and nonionizing radiation areas. The data base consists of the U.S. Census Bureau Master Enumeration District List with coordinates. For each of the 250,000 census enumeration districts (CEDs), the total population and housing units, the state and county code, and the latitude and longitude of the population centroid are given. The average population in a CED is 800, and this is approximately the limit of resolution of the data base. The programs generate the total population within selected distances and angular sectors from a reference point designated by its geographic coordinates. Alternately, the programs can be used as subroutines to make available to another program the distance and bearing of each CED, in a selected region, from a reference point. The potential applications to the population exposure problem are many and examples briefly discussed include single-source discharge from facilities in the nuclear fuel cycle and exposure from nonionizing radiation sources such as radio, television, radar, and microwave transmitters. As an example of the use of this population distribution system, the population exposure from AM radio standard broadcast stations will be discussed in detail. (auth)

2605 (COO-2383-0007) QUARTERLY TECHNICAL PROGRESS REPORT, JANUARY–MARCH 1974. (Illinois Univ., Urbana (USA). Dept. of Computer Science). 1974. 152p. (UIUCDCS-QPR-74-1). Dep. NTIS $10.75.

Programs reported are on circuit research; electronic hardware and software systems; switching theory and logical design; computer organization studies; numerical analysis; aspects of combinatorial computing; theory of digital computer arithmetic; computer science education; computer perception and intelligence; mesh research; and advanced computation techniques. (SFL)

2606 (DESY-74/35) INTEGRABLE CYLINDER FUNCTIONALS FOR AN INTEGRAL OF FEYNMAN-TYPE. Buchholz, D.; Tarski, J. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Jul 1974. 18p. Dep. NTIS (US Sales Only) $4.00.

Integrability of cylinder functionals is investigated, for the Feynman-type integral as defined by Itô. Several classes of integrable cylinder functionals are specified. An inductive property of the integral is established. (auth)

2607 (KAPL-M-7386) DATATRAN 2 IMPLEMENTATION. Kopp, H. J.; Schilling, W. E.; Selengut, D. S.; Stieglitz, R. G.; Hanawalt, K. L.; Urbaniak, J. J. (Knolls Atomic Power Lab., Schenectady, N. Y. (USA)). Oct 1974. Contract W-31-109-eng-52. 198p. Dep. NTIS $13.00.

Datatran 2 is a non-interactive data base management language that is used as the environment for a modular computer program network. This manual describes the programming used to implement the language on CDC-6600 and CDC-7600 equipment. It is intended to serve as a maintenance document at the Bettis Atomic Power Laboratory and KAPL as well as a guide for installation on other computers. More than 80 percent of the programming is in FORTRAN IV. (auth)

2608 (KFK-CAD-Mitt.-1/1973) CAD COMMUNICATIONS. P. I. (Kernforschungszentrum Karlsruhe (F. R. Germany). Projekt Rechnerunterstuetztes Entwickeln und Konstruieren). 1973. 481p. (In German).

The progress report on CAD (computer-aided design) contains important notes, protocols, lectures, abstracts of project reports, literature references, and information about new projects. It is intended to make the progress of the project more available. (GE)

2609 (KFKI-74-53) SOFT: A SUPERVISOR OF FOCAL AND ON-LINE MEASURING TERMINALS. Manno, I. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1974. 41p. Dep. NTIS (US Sales Only) $5.25.

The description is given of the SOFT operating system that runs the FOCAL conversational language and serves on-line measuring terminals. (auth)

2610 (KFKI-74-56) FOCAL IN ON-LINE DATA PROCESSING. Manno, I. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1974. 8p. Dep. NTIS (US Sales Only) $4.00.

FOCAL is developed to be used as processor of on-line processing of bubble chamber data. (auth)

2611 (LA-5479) TEST PROBLEMS FOR HYDROCODES. Fickett, W.; Rivard, W. C. (Los Alamos Scientific Lab., N. Mex. (USA)). Aug 1974. Contract W-7405-eng-36. 32p. Dep. NTIS $4.00.

A collection of exact solutions to the inviscid (Euler) equations of motion is presented for use in testing finite-difference calculations. The emphasis is on problems involving solid explosives and inerts. (auth)

2612 (LA-5511-MS) MBD PRIMER. Shlaer, S. (Los Alamos Scientific Lab., N. Mex. (USA)). Aug 1974. Contract W-7405-eng-36. 28p. Dep. NTIS $4.00.

The elementary programming manual for the LAMPF Microprogrammed Branch Driver (MBD) discusses the properties of the MBD that are most likely to be of concern to the experimental physicist who must incorporate such a device in his data acquisition system. (auth)

2613 (LA-UR-74-1523) COMPUTERIZED INVENTORY/DESIGN SYSTEM FOR GRAPHITE MOLDS. Erickson, W. C.;

Newfield, S. E. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-eng-36. 13p. (CONF-741001-10). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

A computer code was developed to both inventory and design graphite foundry molds. The stock of existing mold cases (exterior wall of mold) is examined in search of a size that can be used for the current casting requirement. Successful candidates are further screened, until one candidate is selected. If none is found in inventory, a new case is designed. A core (interior wall of mold) is designed in every instance, since it is destroyed during removal of the casting. Computer-generated drawings for case, core, and assembly are produced on an x-y plotter. (auth)

2614 (LA-UR-74-1578) INTERACTIVE GRAPHICS SYSTEM FOR MECHANICAL DRAFTING AND DESIGN. Beatty, J. N. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-eng-36. 7p. (CONF-741001-8). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

Mechanical drafting and design using interactive graphics can be made effective by providing the designer with his everyday tools and terminology coupled with the speed of a computer system. A graphics system consisting of current state-of-the-art hardware, and software written in a high level language provides the engineer an effective way to make expansions and changes as use dictates. (auth)

2615 (LA-UR-74-1582) GENERAL PURPOSE PROGRAM FOR MANIPULATING AND ANALYZING TABULAR DATA. Fultyn, R. V. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-eng-36. 9p. (CONF-741001-7). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

ATLAS is a general purpose program for manipulating and analyzing tabular data. Numbers of variables, input and output formats, types and order of manipulative operations are all chosen at execution time. Various sorting, selecting, ordering, and statistical operations are also selectable as are graphical outputs. If necessary, the code can be relatively easily modified to include manipulative operations that are peculiar to a particular data set. Standard manipulations include those found on better scientific calculations (i.e., add, subtract, multiply, divide, log, exponent, trig functions, etc.). Any number of manipulations can be performed in any order. (auth)

2616 (LBL-3004) METHOD TO EXPOSE THE HIDDEN STRUCTURE OF FORTRAN PROGRAMS. Meissner, L. P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 22 Apr 1974. Contract W-7405-eng-48. 19p. (CONF-741101-4). Dep. NTIS $4.00.

From ACM annual conference; San Diego, California, USA (11 Nov 1974).

Program structure is inherent in program design; therefore special keywords such as "if ... then ... else" or "do ... while" are useful only to the extent that they reveal that structure. A simple listing of Fortran program statements is ineffective for revealing program structure. Proposals have been made for manually inserting keywords, comments, indentations, etc., either during a separate preprocessing stage or during the normal coding process. How the flow graph can provide independent structural information is shown. Although the flow graph may be said to exist as soon as a program has been designed, it is most readily generated from the program statements. Bad structure can be detected objectively, and good programs can be reconstituted to reveal their block structure more clearly. Implementation is based on an algorithm suggested by Peterson et al (CACM, August 1973). This algorithm has been extended to automatically detect block exits. (auth)

2617 (LTSS-10(Ed.6)) LIVERMORE TIME-SHARING SYSTEM. Part I. Octopus. Chapter 10. CDC 7600 System Calls and I/O Requests. Du Bois, P.; Coverston, H.; Storch, D.; Powles, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Jul 1974. 108p. Dep. NTIS $8.50.

A system call is a request by a problem program for some function or service to be performed by computer program FLOE or by EEA (the resident executive program). The functions available include accessing files, communicating with terminal devices and with controllers and controllees, obtaining system tables, and information, etc. A problem program issues an I/O request when it requires input or output to be performed by the system. User programs may request to read or write tapes or disk files, or to read from or write to the PDP-10. I/O programs available only to the system include ones to write the drum, read the card reader, and write files to the on-line printer. Examples of how to issue system calls or I/O requests are given. (MCW)

2618 (MHSMP-74-9M) COMPUTER MICRODENSITOMETER (DRUM SCANNER) SYSTEM. Period Covered: January–March 1974. Harris, C. L.; Black, L. W. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 3p. Dep. NTIS $4.00.

The drum scanner-computer system was specifically obtained to look for flaws in HE loaded parts via radiographic analysis. The system components were interfaced in October 1973. Since that time development of software to accomplish the flaw detection and analysis task has been a continuing job. Programs to allow the computer to control the microdensitometer were working successfully by the middle of December 1973. (auth)

2619 (MHSMP-74-9-O) MATHEMATICAL ANALYSIS FOR THE RDX/SYLGARD PRODUCTION PROBLEM. Period Covered: January–March 1974. Ashcraft, R. W. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 14p. Dep. NTIS $4.00.

The results are discussed of the mathematical analysis performed to find a combination of process variables for the continuous precipitation process that will give a yield of RDX above 75% with a surface area of approximately 1100 cm^2/g. Multiple linear regression was performed on the data from 32 test runs. The prediction model for yield involves the acetone flow rate, water temperature, percentage RDX in acetone, and stirring rate. The model accounts for 58.82% of the total variation and has a standard error of estimate of 14%. The surface area model involves the mass of the batch, the water flow rate, and the acetone flow rate. This model accounts for 55.56% of the total variation and has a standard error of estimate of 568 cm^2/g. It is recommended that factorial design be used for further test runs and repeatability of the system should be studied. (auth)

2620 (ORNL-NSF-EATC-7) USER'S MANUAL FOR THE FORTRAN IV VERSION OF THE WISCONSIN HYDROLOGIC TRANSPORT MODEL. Patterson, M. R.; Munro, J. K.; Fields, D. E.; Ellison, R. D.; Brooks, A. A.; Huff, D. D. (Oak Ridge National Lab., Tenn. (USA)). Oct 1974. Contract W-7405-eng-26. 258p. Dep. NTIS $16.00.

A user's guide for the Wisconsin Hydrologic Transport Model (WHTM) is presented to enable the simulation of trace contaminant transport by the hydrologic cycle. The model is based on the Stanford Watershed Model and forms a major component of the Unified Transport Model being developed at ORNL. WHTM includes the hydrologic transport of a trace contaminant by entrainment in overland flow, infiltration, impervious area runoff, and base flow. Chemical exchange reactions are simulated with a simple ion-exchange submodel for interaction with the soil and a sheet erosion submodel for transport of the trace contaminant that is sorbed on the surface of eroded soil particles. Detailed instructions for the application of the WHTM are given, and lists of the FORTRAN IV source decks and sample input data are provided. Simulation of the hourly flow in seven reaches of a stream channel system for a period of one year can be done on the IBM System 360/91 computer in about four minutes. (auth)

2621 (SAND-74-0038) SOME PROGRAMS FOR A HEWLETT–PACKARD 5401 A/B MULTICHANNEL ANALYZER SYSTEM. Sullivan, T. D. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1974. Contract AT(29-1)-789. 53p. Dep. NTIS $5.75.

Several general purpose programs developed for a Hewlett–Packard 5401 A/B Multichannel Analyzer System are described. (auth)

2622 (SAND-74-0099) PROGRAM CYCLE: A RANKINE CYCLE ANALYSIS ROUTINE. Abbin, J. P.; Leuenberger, W. R. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1974. Contract AT(29-1)-789. 72p. Dep. NTIS $4.00.

The computer program CYCLE that models and analyzes various Rankine cycle systems including supercritical cycles with or without regeneration and subcritical cycles with or without regeneration and/or super heat is described. The program will accommodate a variety of working fluids, generating the required thermodynamic properties internally using a modest number of input constants. The program version presented in this report is written in Fortran IV in a conversational mode suitable for timesharing. (auth)

2623 (SAND-74-0143) VISIBLE ARCS OF A CIRCULAR ARC VIEWED THROUGH A WINDOW. Peterson, D. P. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1974. Contract AT(29-1)-789. 40p. Dep. NTIS $5.00.

VISARC is a Fortran subroutine that calculates those portions of a circular arc that are visible through a rectangular window.

For each visible arc it determines the radian measure and the starting position of the arc. (auth)

2624 (SAND-74-0225) STAT/LIB. Anderson, H. E. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1974. Contract AT(29-1)-789. 56p. Dep. NTIS $6.00.

STAT/LIB is a group of statistical programs available on the PDP-10 computer that are useful to practicing engineers and scientists for data analysis. The document briefly describes the routines and their use. (auth)

2625 (SAND-74-0250) TWO SUBROUTINES FOR FINDING SIMPLE PATHS IN A GRAPH. Hulme, B. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1974. Contract AT(29-1)-789. 21p. Dep. NTIS $4.25.

Two quite different algorithms for finding all the simple paths between a pair of nodes in a graph are compared by means of comparing carefully written FORTRAN subroutines for the methods. The path tracing technique performs an exhaustive search through the rows of the adjacency matrix, while the other algorithm uses an analog of Gaussian elimination to solve a system of linear equations in which the unknowns are sets of simple paths. It is shown that path tracing can be faster than Gaussian elimination and also that path tracing is preferable for practical reasons, including very small storage requirements and independence of the node ordering. (auth)

2626 (SAND-74-0254) GOODNESS OF FIT AND PARAMETER ESTIMATION. Easterling, R. G. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1974. Contract AT(29-1)-789. 17p. Dep. NTIS $4.00.

Tradiational approaches to statistics are of the following form: "Given the model, then the best way to form opinions about the parameters is ...". It is proposed that this conditioning be removed and that model fitting and parameter estimation be considered jointly. Examples are given. (auth)

2627 (SAND-74-5156) PROGRAMMABLE CALCULATOR MEASUREMENT SYSTEMS. Darsey, D. M. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 5p. (CONF-741001-5). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

The programmable calculator can often be used as an intelligent controller for measurement and control systems. Use of a calculator rather than a minicomputer can simplify programming and interface hardware with resulting savings in development and maintenance costs. Advantages, disadvantages, and important trade-offs in considering calculators are presented, with the application of a static load testing laboratory as an example. Calculator-based systems are best applied when high speed and large quantities of input-output are not of primary importance. Many scientific laboratories can benefit from the simplified setup and programming of the new calculators. (auth)

2628 (SAND-74-5157) TESTING COMPUTER HIERARCHY NETWORK. Darsey, D. M. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 4p. (CONF-741001-6). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

The development of automated testing facilities, each with its own measurement instruments, minicomputer, and peripherals, has resulted in peripherals and large memory used only for certain tests or quick-look data reduction. A hierarchy network of minicomputers with a large central computer provides sufficient memory and peripherals for efficient software development, data reduction, and storage, yet keeps the individual minicomputer at each facility to a minimum. The system configuration, design philosophy, communication links considerations, and advantages of the system are presented, as well as the future developments required to emphasize the synergistic capabilities of a trilevel hierarchy now being developed at Sandia, Albuquerque. (auth)

2629 (SAND-74-5401) SOME APPLICATIONS OF COMPUTERIZED ULTRASONIC DATA ACQUISITION AND DISPLAY SYSTEM. Gieske, J. H. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 23p. (CONF-741020-1). Dep. NTIS $4.25.

From automated inspection and product control conference; Chicago, Illinois, USA (15 Oct 1974).

A minicomputer data acquisition and display system is described along with a description of an ultrasonic data acquisition computer interface. Fourteen examples of computerized ultrasonic data displays are presented. (auth)

2630 (SAND-74-5537) DEVELOPMENT OF THREEDY: A THREE DIMENSIONAL WAVECODE USING OPERATOR SPLITTING AND WAVEFITTING ON A MOVABLE MESH. Hicks, D. L.; Lauson, H. S.; Madsen, M. M. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 4p. (CONF-741001-4). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

THREEDY is a three-dimensional wavecode being developed at SLA. THREEDY employs the techniques of operator splitting, wavefitting, movable meshes, controlled entropy production, and a conservative, implicit-optional-explicit, discrete scheme. Operator splitting splits the three-dimensional solution operator into one-dimensional operators thereby simplifying the structure of the code. Wavefitting improves the accuracy around wavefronts. A movable mesh alleviates the problem of severe distortion suffered in purely material coordinate wavecodes on hypervelocity impact calculations. However, the basic computation is done in the material Lagrangean frame to keep track of material boundaries and material histories necessary to properly evaluate certain material laws. Implicit differencing is used to avoid the CFL (Courant, Friedrichs, Lewy) timestep restriction. However, for accuracy, timestep restrictions are employed that prevent volumes and energies from changing too much in a subcycle. The explicit option is employed to save time by not iterating to the implicit solution if the CFL timestep restriction happens to be satisfied by the accuracy criterion. Also to improve the accuracy, to avoid the extremes of severe oscillations, and to avoid excessive smearing, controlled entropy production is used. (auth)

2631 (SAND-74-8205) ENGINEERING MATHEMATICS REFRESHER COURSE. Part I. Soderstrand, M. A. (Sandia Labs., Livermore, Calif. (USA)). Sep 1974. Contract AT(29-1)-789. 113p. Dep. NTIS $8.75.

The book is written for a six-week refresher course in algebra, analytic geometry and trigonometry, differential equations, and partial differential equations. Weekly assignments, homework problems, examinations, and lecture notes are included in this text. In addition, reading in other textbooks and optional or reference reading is also assigned. (MCW)

2632 (SAND-74-8222) USER'S GUIDE TO THE SANDIA MATHEMATICAL PROGRAM LIBRARY AT LIVERMORE. Huddleston, R. E.; Jefferson, T. H. (Sandia Labs., Livermore Calif. (USA)). Sep 1974. Contract AT(29-1)-789. 75p. Dep. NTIS $6.75.

The Sandia Mathematical Program Library is a collection of general-purpose mathematical subroutines that are maintained within Sandia on a quick service basis. The document is intended to be a reference guide for using the library at Sandia Laboratories, Livermore. (auth)

2633 (SLA-73-0908A) INSTRUCTIONS FOR USING THE SETS PROGRAM. Worrell, R. B. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1974. Contract AT(29-1)-789. 25p. Dep. NTIS $4.25.

Instructions for using the SETS program are given. The information necessary to obtain access to a permanent file containing various versions of the SETS program is given, as well as SCOPE control card sequences for executing the program on a CDC 6600 under a variety of circumstances. Also, diagnostic messages that can occur during execution are explained and, when appropriate, corrective procedures are suggested. (auth)

2634 (SLA-74-0263) PMRRAD: A COMPUTER PROGRAM TO CONVERT PACIFIC MISSILE RANGE RADAR TRACKING DATA TO TRAJECTORY POSITION DATA. Forsythe, F. E.; Orzel, R. J. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1974. Contract AT(29-1)-789. 57p. Dep. NTIS $6.25.

The function of the PMRRAD computer program is to reduce radar tracking data, generated by the Pacific Missile Range Tracking stations at the Kauai Test Range, to trajectory data. The report describes the program, the mathematics involved, and the several computing and output options available to the user. (auth)

2635 (SLL-73-0248) SCORCH: A COMPUTER CODE FOR CALCULATING AERODYNAMIC HEATING ON REENTRY VEHICLES AND CONTROL SURFACES. Lemmon, E. C.; Bramlette, T. T.; Coleman, H. W. (Sandia Labs., Livermore, Calif. (USA)). Jul 1973. Contract AT(29-1)-789. 49p. Dep. NTIS $5.50.

The computer code SCORCH calculates aerodynamic heating on wedges and sharp or blunt cones at angle of attack. The code can also be used to calculate base heating and pressure on cones, pressure and heat transfer for fins or flaps, and flap aerodynamic coefficients that include viscous effects. (auth)

2636 (TDAI-63) SI METRIC SYSTEM. Whittier, A. C. (Atomic Energy of Canada Ltd., Sheridan Park, Ontario. Power Projects). Jan 1973. 38p. Dep. NTIS (US Sales Only) $3.00.

In 1960 the General Conference on Weights and Measures (CGPM) adopted "Le Système International d'Unités", known as the SI system. The units, definitions, and formalism of SI as they stand as of March 1972 are described. Some conversion factors, historical data, and a short bibliography are included. (auth)

2637 (TRG-Report-2524(S)) FIRECRACKER 2 (HELLFIRE 2): A PROGRAM FOR THE CALIBRATION OF X-RAY POWDER DIFFRACTOMETERS. Eastham, M. A.; Ferguson, I. F.; Hughes, T. E. (UKAEA Reactor Group, Springfields). 11 Jan 1974. 17p. Dep. NTIS (US Sales Only) $4.00. UK 50 pence.

A Fortran program, FIRECRACKER 2, is described that determines calibration constants for an x-ray powder diffractometer from measurements made on a standard material that possesses cubic symmetry and a known lattice parameter. These calibration constants are based on any specified number of linear regressions that is compatible with the data given. (auth)

2638 (TRG-Report-2524(S)) FIRECRACKER 2 (HELLFIRE 2): A PROGRAM FOR THE CALIBRATION OF X-RAY POWDER DIFFRACTOMETERS. Eastham, M. A.; Ferguson, I. F.; Hughes, T. E. (UKAEA Reactor Group, Springfields). Aug 1974. 16p. Dep. NTIS (US Sales Only) $4.00. UK 50 pence.

A Fortran program, FIRECRACKER 2, is described that determines calibration constants for an x-ray powder diffractometer from measurements made on a standard material that possesses cubic symmetry and a known lattice parameter. These calibration constants are based on any specified number of linear regressions that is compatible with the data given. (auth)

2639 (UCID-15680) INPUT FOR 6600 PHOTON SORS. Ratcliffe, E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1968. 32p. Dep. NTIS $4.75.

2640 (UCID-30040(Ed.5)) TRIX AC: A SET OF GENERAL-PURPOSE TEXT EDITING COMMANDS. Cecil, A.; Moll, H.; Rinde, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Oct 1974. Contract W-7405-Eng-48. 57p. Dep. NTIS $6.00.

TRIX is an interactive interpreter. AC is a dialect written in the TRIX language. The AC dialect is a translator. It translates a simple user command into the formal TRIX format and drives the interpreter. All the commands in the AC dialect of TRIX are described. (MCW)

2641 (UCRL-51611) METHOD FOR THE CONSTRUCTION OF THREE-DIMENSIONAL ELECTRON MICROGRAPHS. Grabske, R. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Sep 1974. Contract W-7405-eng-48. 5p. Dep. NTIS $4.00.

A method is described for the construction of three-dimensional pictures from the computer output of the polytropic montage process for three-dimensional representation in electron microscropy. The final computer output is a series of two-dimensional images on photographic film, each of which corresponds to one increment in the third dimension. These film positives (dark images on light background) are stacked alternately with U-shaped spacer bars, with aluminum backing plates top and bottom. The entire assembly is bolted together firmly to form a mold. The mold is subsequently filled with a transparent plastic monomer and polymerized by heat. (auth)

2642 (UCRL-75130) NEED FOR AUTOMATED SYSTEM SPECIFICATIONS AND DESIGNS. Frazer, J. W.; Kray, A. M.; Boyle, W. G.; Morris, W. F.; Fisher, E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Apr 1974. 11p. (CONF-740314-4). Dep. NTIS $4.00.

From 25th Pittsburgh conference on analytical chemistry and applied spectroscopy; Cleveland, Ohio, USA (4 Mar 1974).

Procedures to develop an automated system for on-line data acquisition and processing are outlined. A definition of the system is made, the tasks to be accomplished by the automation are outlined, and then a full set of system specifications and a functional design are stated. These phases of the project were accomplished without consideration of any specific hardware. A 3.4-meter emission spectrometer is used as an example for automation. (MCW)

2643 (UCRL-75716) PNEUMATIC LOGIC INTERFACE FOR VALVE THROTTLING. Hugenberger, C. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Jul 1974. 16p. (CONF-741015-5). Dep. NTIS $4.00.

From 21st national symposium of the American Vacuum Society; Anaheim, California, USA (19 Oct 1974).

A description is given of pneumatic logic used as a logic interface to modify the air signals to an ordinary pneumatic valve so that both manual and automatic controls are available to the user, side by side. Because electrically controlled logic systems dominate the field, the circuit described is designed to be compatible with such systems without modification. (MCW)

2644 (UCRL-75795) ASTM E-31 COMPUTERIZED LABORATORY SYSTEMS. Frazer, J. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Jun 1974. 22p. (CONF-741014-3). Dep. NTIS $4.25.

From Instrument Society of America conference; New York, New York, USA (28 Oct 1974).

The ASTM E-31 Computerized Laboratory Systems was organized in 1970 for the promotion of knowledge, stimulation of research, standardization of nomenclature, and recommendation of procedures and practices for definition, implementation, documentation, and evaluation of computerized laboratory systems. The organization of the committee is outlined. (MCW)

2645 (UCRL-76114) TESTING AND EVALUATION OF INFORMATION SECURITY IN LARGE SYSTEMS. Abbott, R. P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1974. 28p. Dep. NTIS $4.50.

The problem of protecting the security of large time-sharing multiterminal computer systems is complicated by the fact that the programs controlling the execution of its tasks (i.e., the operating system) are susceptible to unauthorized control, deception or compromise. The current state of research in operating-system security is described and the work of one such research activity, the LRL RISO Project (for Research In Secured Operating Systems) is examined in detail. Also discussed are operating-system security aspects of Control Data Corporation 6000 and 7000 series machines. (auth)

2646 (WAPD-TM-1181) REFERENCE MANUAL: Bettis Programming Environment. Cadwell, W. R. (ed.). (Bettis Atomic Power Lab., Pittsburgh, Pa. (USA)). Sep 1974. Contract AT(36-1)-Gen-14. 132p. Dep. NTIS $9.75

The Bettis programming environment consists of a large number of subroutines and functions that are available for use in application programs. These routines effectively extend the Fortran language in such areas as system communication, decimal input, file management, scratch I/O, storage allocation, and plotting. The intent is to maintain all system dependent routines in a well-documented central library and thus to minimize system conversion problems for an extensive collection of Fortran programs. Almost all of the environmental routines are themselves written in Fortran to further reduce conversion effort; this has little effect on program efficiency but does increase the amount of memory required. (auth)

Miscellaneous

2647 (ANL/ES-36) ECONOMIC EVALUATION OF THE PROPOSED ILLINOIS COMPLEX SOURCE REGULATION. Cohen, A. S.; Tschanz, J. F.; Seyfreid, R. K. (Argonne National Lab., Ill. (USA)). Aug 1974. Contract W-31-109-Eng-38. 155p. Dep. NTIS $10.75.

Comparisons are made of the costs of the federal indirect source and the proposed Illinois complex source regulations. The analysis, delay, modification, and phasing costs associated with the regulations are discussed, and all but the phasing costs are the most important and that regional shopping centers incur the largest relative costs. Various parametric analyses are conducted to determine the sensitivity of the cost estimates to the apportionment scheme used in the regulation and to the federal new-car emission standards. (auth)

2648 (ARH-2251) REMOTE SENSING OF SOUTHEASTERN WASHINGTON. Part I. Infrared Scanning Imagery. Godfrey, W. L.; Brown, D. J.; Veatch, M. D. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). Jan 1972. 62p. Dep. NTIS $7.60.

Industry is interested in facilities to withstand earthquakes. Remote sensing could be available for an area identifying geologic data prior to construction. Remote sensing data from a number of spectra that were obtained on and adjacent to the AEC's Hanford Reservation and which may be useful in identifying anomalies related to the seismic stability of the area are presented. High-altitude (10,000 feet) IR scan data were obtained over an area encompassing about 15,000 square miles in southeastern Washington. The resulting film imagery was mounted and reviewed from three points of view: (1) Can the existence of purported faulting be confirmed by the IR record?; (2) Can thermal lineaments observed in the IR record be attributed to faulting?; and (3) Are there other geologic features that can be uniquely identified from the IR record? (MCW)

2649 (BDX-613-1150(Rev.)) MAXIMUM HUMIDITY INDICATOR. Final Report. Abel, W. B. (Bendix Corp., Kansas City, Mo. (USA)). Oct 1974. Contract AT(29-1)-613. 20p. Dep. NTIS $4.00.

Moisture-sensitive systems to measure and indicate the maximum level of humidity exposure are discussed. A chemical indicator utilizing deliquescent salts and water-soluble dyes provides an irreversible color change at discrete levels of relative humidity. To provide indication of the time at which the exposure occurs, a circuit employing a resistive-type sensor was developed. A small, commercially available sensor is used in a portable probe to detect humidity leaks into controlled areas. (auth)

2650 (BNL-19111) ESTIMATION OF HOUSING AND POPULATION DATA FROM ELECTRIC METER RECORDS. Tessmer, R. G. Jr. (Brookhaven National Lab., Upton, N. Y. (USA)). [nd]. 31p. (CONF-740834-1). Dep. NTIS $4.75.

From meeting of the Urban and Regional Information Systems Association; Montreal, Canada (22 Aug 1974).

The Department of Urban Development in Cincinnati studied the feasibility of extracting statistical data from electric meter records. Estimation of single and multi-family vacancy rates by census tracts was investigated from this data. Results indicate that single and multi-family vacancy rates in private market housing can be estimated from electric meter records within approximately 1% of true rates. This is sufficiently accurate to indicate differences in housing market behavior between neighborhoods. It also identifies changes within a given neighborhood over time. Data is presently generated at six month intervals, and historical data exists back to June, 1969. (MCW)

2651 (CEA-R-4612) EXPERIMENTAL STUDY OF AN ALUMINIUM OXIDE HYGROMETER. Utilization of a Balloon-Borne System for Stratospheric Sounding. Pleyber, G. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Applications Speciales de la Physique). Sep 1974. 83p. (In French). Dep. NTIS (US Sales Only) $7.25.

A balloon-borne system for determining stratospheric water vapor content through the use of a variable impedance technique is described. An account is given of the construction, properties, and calibration of the hygrometer based on the adsorption mechanism of water vapor in an anodized aluminium film. Low-temperature calibration (below 0°C) is difficult. Improvements are suggested that would make use of the sensor in the usual practice. (tr-auth)

2652 (CONF-740726-1) PHOTOELECTRON AND PHOTOION SPECTROSCOPY OF MOLECULES. Berkowitz, J. (Argonne National Lab., Ill. (USA)). 1974. 50p. Dep. NTIS $5.50.

From 4th international conference on vacuum ultraviolet radiation physics; Hamburg, F. R. Germany (22 Jul 1974).

In the review of the photoelectron and photoion spectroscopy of molecules the developments are systematized with particular emphasis on the most recent results. The coverage includes photoelectron spectroscopy and photoionization mass spectrometry. (JFP)

2653 (CONF-740833-1) SOME APPLICATIONS OF THERMOLUMINESCENCE MEASUREMENTS IN ANCIENT CERAMICS. Becker, K.; Moreno y Moreno, A. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 22p. Dep. NTIS $4.25.

From fourth international conference on luminescence dosimetry; Krakow, Poland (27 Aug 1974).

The feasibility of using an unmodified commercial thermoluminescence dosimetry (TLD) reader (Harshaw 2000) for the measurement of integrated TL signals in ancient ceramics was demonstrated with a variety of precolombian potsherds from various parts of Mexico up to ~3000 y old, as well as modern pottery including faked "precolombian" artifacts. The techniques for carrying out such tests (sample preparation, calibration, reader operation) are described briefly, focusing on the measurement of the TL signal from the interior of large (100 to 175 μm) quartz grains extracted from the ceramic. After substracting the surface alpha radiation dose, the internal penetrating environmental gamma radiation level at the location of the ceramics is obtainable, and may be used as a baseline for comparisons with contemporary levels. (auth)

2654 (DESY-74/34) EQUILIBRIUM STATES OF INFINITE QUANTUM SYSTEMS. Trych-Pohlmeyer, E. B. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Jul 1974. 31p. Dep. NTIS (US Sales Only) $4.75.

Thesis. Submitted to Univ., Hamburg.

Equilibrium states of infinite quantum systems are classified in the algebraic framework without recourse to the finite systems. The example of an infinite ideal Fermi gas is considered. (JFP)

2655 (ORNL-TM-4700) AVIAN COMMUNITY ANALYSIS OF WALKER BRANCH WATERSHED. Anderson, S. H.; Shugart, H. H. Jr. (Oak Ridge National Lab., Tenn. (USA)). Oct 1974. Contract W-7405-eng-26. 168p. Dep. NTIS $11.50.

Information was summarized on the behavior and population dynamics of the avian community, relating it to the vegetation making it useful in predicting the effects of habitat alteration, determining avian community interrelationships, and relating the avian community to other components of the ecosystems. A data base of an avian community in a decidious forest was developed. These data are useful as a basis for predicting the effect of habitat alteration on the bird community. Information is available on species and community composition, activity, and habitat utilization on a daily, seasonal, and annual basis. Walker Branch Watershed is located on the U. S. AEC Oak Ridge Reservation in eastern Tennessee at latitude 35° 58′ N, longitude 84° 17′ W. The watershed covers 97.5 ha, ranges in elevation from 285 to 375 m, and occupies an area of steeply sloping ridges and narrow valleys. (MCW)

2656 (UCID-16575) DYNAMICS OF AEROSOLS AND HYDROSOLS: CLASS NOTES. Morrison, F. A. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1974. Contract W-7405-Eng-48. 246p. Dep. NTIS $15.50.

Aerosols are defined as a small particle suspended in air. Hydrosols are defined as small particles suspended in water. Many analyses and methods of analysis apply equally well to aerosols or hydrosols and conclusions depend on the magnitudes of physical properties in gases and in liquids. Solid particles are considered in gas or in liquid, liquid particles or drops in gas or in liquid, and gaseous particles or bubbles in liquids. Dispersion aerosols, liquid aerosols, and dusts are defined. Three section titles are: Some Fluid Kinematics and Dynamics; Some Geometry and Notation; Axisymmetric Flow; and Motion in a Continuum. 87 references. (MCW)

2657 (UCRL-51632) COUNTERFORCE EXCHANGE STRATEGIES. Reinhardt, G. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 Jul 1974. Contract W-7405-eng-48. 12p. Dep. NTIS $4.00.

Using game theory the question of optimal retaliatory responses by a nuclear power to a limited strategic ICBM counterforce strike by another nuclear power is explored. These studies suggest that response options exist which either preserve the force balance or change it in favor of the side that is attacked. An appropriate generalized utility function is defined and a game matrix that can be used to analyze opposing strategies is constructed. An example is presented for the case of "equivalent" ICBM forces. The outcome of the game is sensitive to both tactics and technology. For example, there is an optimal game strategy for both players, and the penalty for deviating from it is often severe. Technological disparities in such things as number of MIRVs, delivery accuracy, satellite and radar intelligence, and quick-launch capability affect the results. The game suggests a way to answer two operational questions: "What is the optimal response to a given attack?" and "What is the optimal first-strike strategy?" Matters both technical and political indicate that these questions are of real interest today. (auth)

2658 (UCRL-75896) NUMERICAL MODELING OF PRECIPITATION SCAVENGING BY CONVECTIVE CLOUDS. Molenkamp, C. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1974. 41p. (CONF-741003-4). Dep. NTIS $5.25.

From precipitation scavenging conference; Champaign, Illinois USA. (13 Oct 1974).

The precipitation scavenging studies answered two main questions: (1) What is the amount and distribution of pollutant deposited on the ground by precipitation? and (2) How much of the pollutant is left in the atmosphere, and what is the spatial distribution of this remaining pollutant? A one-dimensional model of cumulus convection with parameterized microphysics modified to include a scavenging calculation has given answers to these questions for a particular situation. A typical convective cloud can easily deposit efficient condensation nuclei initially suspended at low levels in amounts equal to the initial vertical integral of the pollutant material. For larger clouds and greater nucleation efficiencies several initial vertical integrals could be rained out. The amount of pollutant left behind in the atmosphere in the vertical column where the cloud existed can be larger than the initial vertical integral of pollutant even when the material is efficiently scavenged. This result indicates that the region of the atmosphere that has a small amount of pollutant after being influenced by convective clouds is the region between clouds where air with a lower concentration of pollutant has been advected to lower levels replacing air with a higher concentration of pollutant. (MCW)

2659 ATOMIC ENERGY COMMISSION. Allardice, C.; Trapnell, E. R. Praeger Library of U.S. Government Departments and Agencies. New York; Praeger Publishers, Inc. (1974). 249p. $10.00.

This book traces the origins of the AEC from Einstein's letter to Franklin D. Roosevelt, through the first chain reaction, to the

struggle for control of the atom that terminated in the Atomic Energy Act of 1946, which gave control to a commission of civilians. Another chapter is devoted to the present-day organization of the agency and describes the complex of universities and industries engaged in atomic work, their associated professors and businessmen, and the Commission's scientific and advisory bodies. Still other chapters are devoted to the following topics: men, machines, and materials vital to the agency's work; release of technical information to industry and the public; the relations of the AEC with Congress; secrecy and the question of national security, which came to a head in the case of J. Robert Oppenheimer; and weapons testing, research on biological hazards, the dangers of nuclear contamination, and atomic and nuclear power as a source of energy. (RWR)

Chemistry

2660 (AERE-R-7767) SECONDARY ION ANALYSIS. Poole, D. M.; Jackson, C. K. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Jul 1974. 42p. Dep. NTIS (US Sales Only) $5.25.

An outline is given of the technique of secondary ion analysis in which relatively low energy primary ions are used to stimulate secondary ion emission for localized analysis. The so-called SIMS equipment for monolayer studies, and probe and imaging instruments for achieving lateral resolution of about 1 μm are described. Various examples of applications of the technique, drawn largely from the field of corrosion studies, are presented. (auth)

2661 (BDX-613-1154(Rev.)) EFFECTS OF BORIC ACID ON THE CURE OF BORON-FILLED Y-3602 SILICONE GUM. Leichliter, G. E. (Bendix Corp., Kansas City, Mo. (USA)). Oct 1974. Contract AT(29-1)-613. 11p. Dep. NTIS $4.00.

A project to evaluate characteristics that affect the processability of Y-3602 silicone gum is summarized. An evaluation was made of cure versus material cross-linking. The effects of boric acid on the cure of Y-3602 silicone gum, is being studied. Results of studies of solvents indicated that chloroform and cyclohexane had good reproducibility. Both of these solvents showed essentially the same percent solubles and boric acid content, but the chloroform extract had a higher amine content. Examination of the infrared spectrum of the chloroform residue revealed a strong peak characteristic of a nitrogen-containing compound which was absent in the cyclohexane residue. In addition, the gel permeation chromatography (GPC) curves indicated that chloroform extracted more low-molecular-weight material than did the other solvents. Because of the excellent reproducibility, the higher amine content, the infrared spectrum, and the GPC data, chloroform was selected as the best solvent for future extractions. Results of tests showed that extraction, with chloroform, of a 40-gram sample of boron-filled Y-3602 silicone gum was essentially complete at the end of 4 hours. (auth)

2662 (BDX-613-1207(Rev.)) COMPARISON OF ALTERNATE MATERIALS FOR MOCA CURED ADIPRENE L-100. Final Report. Caruthers, D. J. (Bendix Corp., Kansas City, Mo. (USA)). Oct 1974. Contract AT(29-1)-613. 15p. Dep. NTIS $4.00.

Five cast elastomers were compared with du Pont's Adiprene L-100/MOCA and Conap's EN-7. The differences in physical, electrical, and dynamic properties were evaluated and a properties chart was prepared showing differences and similiarities. A new technique for characterizing and screening cast elastomers using a mechanical spectrometer was used. This instrument will be useful for determining mechanical changes in material caused by temperature. Two materials showed little lowering of shear modulus properties from 0 through 140°C. Of the two materials, Adiprene L-100/Caytur 21 has been further characterized. The other material, Adiprene L-100/HD3928 requires additional testing. (auth)

2663 (IS-T-638) CHEMILUMINESCENT DETECTION OF METALS IN LIQUID CHROMATOGRAPHY. Strom, B. M. (Ames Lab., Iowa (USA)). Oct 1974. Contract W-7405-eng-82. 47p. Dep. NTIS $5.45.

Thesis.

A detector for liquid chromatography is described that uses the metal-catalyzed hydrogen peroxide oxidation of luminol (5-amino-2,3-dihydro-1,4-phthalazinedione) to monitor metal ions in column effluents. The effects of pH, flow rate, distance of the flow cell from the point of mixing, and the solvent type on the reaction of luminol are investigated. Several metals are surveyed for their ability to catalyze the luminol reaction. Cobalt(II), ruthenium(IV), gold(III), chromium(III) and copper(II) are found to be particularly effective catalysts. A method for the separation of cobalt from nickel and chromium and a method for the subsequent determination of cobalt using chemiluminescent detection is reported. The results of the determination of cobalt in two National Bureau of Standards samples are shown. The calibration plot for cobalt is linear over a range of 0.4 to 100 ng. (auth)

2664 (KFK-1975 UF) CHEMICAL REACTIONS OF ATMOSPHERIC POLLUTANTS. Becker, K. H.; Filby, W. G.; Guenther, K. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Radiochemie). May 1974. 112p. (In German and English). Dep. NTIS (US Sales Only) $8.75.

The homogeneous removal rate of sulfur dioxide from the lower atmosphere of Central Europe has been calculated on the basis of the photophysical data of SO_2 within its absorption bands (2900 to 4000 Å) and the measured monochromatic actinic irradiance (solar quantum flux) in Central Europe. The maximum rate of the sunlight-induced photooxidation was found to be 0.25% per hour. This value is compared with those obtained from experiments in simulated and real atmospheres. (auth)

2665 (MHSMP-74-19-B) THERMAL PROPERTIES. Period Covered: April–June 1974. Myers, L. C. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. 21p. Dep. NTIS $4.25.

For Univ. of California Lawrence Radiation Lab., Livermore.

Chemical reactivity test data are presented for PETN samples, that were thermally stabilized, that contained different impurities, and that were recrystallized from different solvents and different recrystallization methods. A preliminary test was conducted to determine if PETN could be sublimed through a hot bed and the products collected in a trap. The trap was successful in collecting a number of different products. Mass spectrometric and gas chromatographic analyses were used. Heat of fusion measurements were made using a 15 bit analog to digital converter and a new computer program. The repeatability of the calibration constant was definitely improved and the heat of fusion measurements for PETN show a small improvement. The heats of fusion for 32 samples of LX-13 grade PETN are reported and data are presented which show that some PETN is lost from the DSC-1 sample cups when they are crimped. The weight loss of PETN sample used for the heat of fusion measurements (after melting) were determined and the loss approximates the amount of acetone trapped in the PETN. The PETN control sample (Lot 1072-426-12) was tested twice this quarter and the results are in agreement with those obtained during the last two years. (auth)

2666 (MHSMP-74-20-C) RDX/SYLGARD. Period Covered: April–June 1974. Slape, R. J. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 9p. Dep. NTIS $4.00.

Analysis for HMX content of the 22 kg batch of purified RDX was completed along with the compositional analysis of 80/20, 85/15 and 90/10 RDX/Sylgard batches made from a large 4-kg batch precipitated from the purified RDX. One copper cylinder test on 85/15 RDX/Sylgard was fired. In conjunction with the efforts to obtain detonation pressure versus composition for RDX/Sylgard, a two-shot aquarium series on 80/20 RDX/Sylgard was fired and efforts were begun on a similar series for 90/10 RDX/Sylgard to supplement the previously fired 85/15 RDX/Sylgard. Preliminary optimum time and temperature for cure data was generated. Two outside orders for Sandia closely related to RDX/Sylgard evaluation were completed with the loading of stainless steel driver subassemblies for Sandia, Albuquerque and Unicores for Sandia, Livermore with 85/15 RDX/Sylgard. (auth)

2667 (MHSMP-74-20-D) DETERMINATION OF DEGREE OF CURE OF ISOTHERMALLY AGED RDX/SYLGARD. Period Covered: April–June 1974. Clink, G. L. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 11p. Dep. NTIS $4.00.

Research is reported in a program to determine the rate of chemical and physical cure of RDX/Sylgard (80/20 and 85/15 percent by weight) as a function of temperature, through NMR analysis and Shore durometer measurements of the isothermal residues, and to establish a cold storage shelf life for these materials. (auth)

2668 (MHSMP-74-20-F) DEVELOPMENT OF PAST EXPLOSIVES: LIQUID CARRIER EVALUATION, APRIL–JUNE 1974. Faubion, B. D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 5p. Dep. NTIS $4.00.

Two different forms of crystals have been grown from liquid 1,4,4,10,10,13-hexafluoro-1,1,7,7,13,13-hexanitro-3,5,9,11-tetraoxatridecane (ADDF). These crystals are probably two of the six impurities which have been detected in the sample by thin layer chromatography. One crystal form either melts or dissolves between 238.1 and 241.5°K and the other between 245.0 and 249.6°K. (auth)

2669 (MHSMP-74-20-G) TATB PILOT PLANT ACTIVITIES FY 74, APRIL–JUNE 1974. Quinlin, W. T.; Evans, V. E.; Estes, Z. L. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 7p. Dep. NTIS $4.00.

The pilot plant was devoted to the production of development quantities of triaminotrinitrobenzene (TATB) for 4-½ months of FY 74. During this time quantities of TATB were produced for LASL and LLL and process development work was done on a process development project. (auth)

2670 (MHSMP-74-20-H) TATB SOLVENT STUDY, APRIL–JUNE 1974. Clink, G. L. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 6p. Dep. NTIS $4.00.

Activities are reported in a search for a solvent system for 1,3,5-triamino-2,4,6-trinitrobenzene (TATB) used in control of particle size and surface area, and for facilitating product characterization through chemical analysis. (auth)

2671 (MHSMP-74-20-J) CORRELATION STUDY ON PROCESSING VARIABLES IN TATB SYNTHESIS. Period Covered: April–June 1974. Ashcraft, R. W.; Duncan, A. A. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 27p. Dep. NTIS $4.50.

A study performed on the recorded process variables from 91 batches of synthesized triaminotrinitrobenzene (TATB) is summarized. The problem was to find any significant correlation that might exist between the product characteristics and amination process variables so that the variation in the final product could be reduced and a consistently good material produced by controlling the important process variables. Graphical and correlation analyses failed to show the presence of a dominant process variable, indicating that the influence on the measurement variables is a multivariate relationship. Multiple linear regression was used to obtain prediction models for the measurement variables and to determine the percentage of total variation explained by the process variables. Results showed that a large amount of variation in the data could not be explained by these variables. Approximately 30% of the variation in particle characteristics and 17% of the variation in chlorine content was explained by the models. The remaining variation is attributed to (1) the possible existence of a significant variable or variables which were not sufficiently controlled in the synthesis, (2) a lack of precision in the process variables, (3) significant errors introduced by mathematical modeling, and (4) error introduced by the measurement technique. A factorial experimental design is recommended for obtaining data which will yield more information. (auth)

2672 (MHSMP-74-20-K) TATB GAP TESTING, APRIL–JUNE 1974. Kramer, P. E. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 5p. Dep. NTIS $4.00.

A study was initiated to see if there is any possibility of testing pure triaminotrinitrobenzene (TATB) in the standard LASL small scale gap test. (auth)

2673 (MHSMP-74-20-L) CHEMICAL ANALYSIS OF TATB, APRIL–JUNE 1974. Faubion, B. D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 9p. Dep. NTIS $4.00.

Raman spectrophotometry, polarography, and calorimetry have been investigated as possible techniques for characterizing production batches of triaminotrinitrobenzene (TATB). Thus far these methods have been unsuccessful. (auth)

2674 (MHSMP-74-20-N) PARTICLE CHARACTERIZATION OF TATB, APRIL–JUNE 1974. Duncan, A. A. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 10p. Dep. NTIS $4.00.

Particle characterization of triaminotrinitrobenzene (TATB) has been performed for each batch of Pantex synthesized TATB. Characterization has been primarily done by sieve analysis using a sieve nest ranging from 180 to 10 μm. From this sieve nest the weight percentages finer than 44 and 20 μm are determined as well as the arithmetic mean for the distribution. Sieve analysis for each batch is given in this report. (auth)

2675 (MHSMP-74-20-P) FORMULATION AND PROCESSING OF TATB PBX. Period Covered: April–June 1974. Stallings, T. L.; Quinlin, W. T.; Osborn, A. G. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 7p. Dep. NTIS $4.00.

Work began on the formulation of the new triaminotrinitrobenzene (TATB) paste explosives to support LLL requirements. Thirteen batches, using the Estane 5702-F1, Viton A and Kel-F 800 binders, were made to supply material for investigating various formulation and pressing parameters. Two separate blends of TATB powder, 227 and 217 kg, were made to furnish large uniform raw powder lots. (auth)

2676 (ORNL-4999) PREDICTION OF OSMOTIC AND ACTIVITY COEFFICIENTS FOR ELECTROLYTE MIXTURES AT ELEVATED TEMPERATURES. Lietzke, M. H.; Stoughton, R. W. (Oak Ridge National Lab., Tenn. (USA)). Sep 1974. Contract W-7405-eng-26. 17p. Dep. NTIS $4.00.

In fields such as geothermal energy and desalination it is necessary to have thermodynamic information on aqueous mixed electrolyte solutions over wide ranges of temperature. Direct measurements, particularly above 100°C, are difficult experimentally and very time consuming. Hence, it is desirable to develop methods for predicting properties such as osmotic and activity coefficients for electrolyte mixtures at elevated temperatures. It is demonstrated that simple expressions developed for predicting such quantities for electrolyte mixtures at 25°C function equally well at elevated temperatures. Because of the success of these predictions it is concluded that the techniques used in the calculations presented in this report could be used to predict closely osmotic and activity coefficient behavior in as yet unstudied systems, such as the solutions of geothermal interest. (auth)

2677 (ORNL-TM-4665) PURIFICATION OF IRIDIUM BY AN OXIDATION-DISSOLUTION PROCESS. Federer, J. I. (Oak Ridge National Lab., Tenn. (USA)). Oct 1974. Contract W-7405-eng-26. 29p. Dep. NTIS $4.50.

A method for purifying iridium has been demonstrated and applied to the treatment of about 9 kg of iridium powder and sheet scrap having impurity contents ranging from 0.6 to 3.7%. The process involves high-temperature oxidation of impure iridium to volatile IrO_3, which subsequently condenses as IrO_2. Some impurities remain in the hot zone of the furnace and some pass out of the system as volatile oxides. Impurity oxides that condense with the IrO_2 are leached with various acid solutions. Finally, the purified IrO_2 is reduced to metal with hydrogen. The iridium was oxidized by contact with oxygen at 1100°C in silica glass tubes. The rate of formation of IrO_2 was faster for sheet scrap and coarse lumps (about 10 g/day per apparatus) than for more finely divided material (about 7 g/day per apparatus), because the latter sintered into a mass of lower surface area. The product iridium was as pure as 99.98%, although some with a residual tungsten content of 300 ppM was only about 99.93% pure. The final product was –40-mesh iridium powder, which was pressed into compacts and sintered in preparation for melting and ultimate fabrication into sheet. (auth)

2678 (RFP-Trans-163) GAS CHROMATOGRAPHIC HEAD SPACE ANALYSIS AND POSSIBILITIES FOR ITS USE. Kolb, B. Translated from CZ-Chem.-Tech.; 1: No. 2, 87-91(1972). 9p. Dep. NTIS $4.00.

The fundamentals of gas chromatographic head space analysis are discussed, especially in regard to the problems of quantitative analysis for liquid and solid samples. The practical procedure of head space analysis with a special dosing system is described and possibilities for application in analysis of liquid components in food, plastics, waste water, and other liquid and solid samples are given. (auth)

2679 (UCID-15330) ANALYSIS OF THE EXPLOSIVE LX-09-0. Selig, W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 May 1968. 9p. Dep. NTIS $4.00.

Procedures for the analysis of the explosive LX-09-0 containing 1, 3, 5, 7-tetranitro-1, 3, 5, 7-tetraazacyclooctane (HMX), poly (2, 2-dinitropropylacrylate) (DNPA), and bis (2, 2-dinitro-2-fluoroethyl) formal (FEFO) are presented. DNPA and FEFO are coextracted with 1, 2-dichloroethane, yielding a residue of HMX. FEFO is determined by combustion of the explosive in an oxygen bomb, the resulting fluoride being titrated with thorium nitrate. DNPA is calculated by difference or may be determined from its absorption near 1750 cm^{-1} in dimethylsulfoxide solution. (auth)

2680 (UCID-15475) ANALYSIS OF EXPLOSIVES CONTAINING 1,3,5,7-TETRANITRO-1,3,5,7-TETRAZACYCLOOCTANE (HMX), BIS(2,2-DINITRO-2-FLUOROETHYL) FORMAL (FEFO), AND POLYESTERS. Selig, W.; Crossman, G. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Jun 1969. 8p. Dep. NTIS $4.00.

A procedure for the analysis of two extrusion-cast explosives containing 1,3,5,7-tetranitro-1,3,5,7-tetrazacyclooctane (HMX), bis(2,2-dinitro-2-fluoroethyl)formal (FEFO), and two polyesters is presented. FEFO is determined by combustion of the explosive in an oxygen bomb; the resulting fluoride is titrated with thorium nitrate in the presence of methylthymol blue or, potentiometrically with lanthanum(III). The other components are determined by sequential extraction. The ratio of residual polymer to the com-

ponents coextracted with FEFO permits an estimate of the degree of cross-linking of the polymer. (auth)

2681 (UCRL-13601) CHEMICAL HEAT SOURCES. Final Report. (Detonics Corp., Seattle, Wash. (USA)). [nd]. 79p. Dep. NTIS $7.00.

For Univ. of California, Lawrence Livermore Lab.

Work was undertaken to identify chemical heat sources which can bring a metal such as aluminum contained in a tantalum vessel from ambient to 1500°C. Five different fuels and twelve different oxidizers were identified as potential components in a mixture possessed of the desired characteristics: large amount of heat available at 2000°K, good heat transfer characteristics, insensitivity, long term stability, and no reaction products boiling below 1800°K. Six mixtures were then selected for additional tests on the basis of (1) usefulness in the device, itself and (2) usefulness in characterizing other mixtures in the same class. The results are as follows: All mixtures are dry, non-hygroscopic, non-pyrophoric powders which are stable, non-corrosive, and insensitive (ignition temperatures above 380°C) yet they are ignited easily and reliably by standard means. All mixtures may be pressed in place, without binders, to form relatively tough solids. Mixtures of flake aluminum and metal (Cu, Mn, or Mo) oxides can be pressed to produce hard pellets without use of binders or mold release agents. Aluminum–barium chromate and titanium based mixtures will not require a binder but may need a mold lubricant, e.g., graphite, MoS, or talc. Useful heat varies from 300 cal/gram for Al–$BaCrO_4$ to 620 cal/gram for Al–CuO. The Al–$BaCrO_4$ can be used as is to develop the prototype. More energetic mixtures will have to be modified so that they do not produce the heat faster than it can be used. This is not seen as a major problem. The information now available is sufficient to begin development of one or more prototype devices. (auth)

Life Sciences

2682 (CONF-7306102-1) INVESTIGATIONS FOR GENETIC EFFECTS OF HYCANTHONE IN MAMMALS. Russell, W. L. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 8p. Dep. NTIS $4.00.

2683 (CONF-740832-1) BASIS OF LYMPHOCYTIC CONTROL OF HEMOPOIESIS. Goodman, J. W.; Basford, N. L.; Shinpock, S. G. (Oak Ridge National Lab., Tenn. (USA)). 1974. 6p. Dep. NTIS $4.00.

From fifth international congress of Transplantation Society meeting; Jerusalem, Israel (22 Aug 1974).

2684 (CONF-740939-1) CONTINUOUS FLOW ROTORS FOR LEUCOCYTE SEPARATION: THEORY, DESIGN, AND EXPERIMENTAL OBSERVATIONS. Remenyik, C. J.; Sartory, W. K.; Brantley, J. N.; Breillatt, J. P. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 26p. Dep. NTIS $4.50.

From international symposium on leucocyte separation and transfusion; London, UK (9 Sep 1974).

2685 (COO-1300-47) ORGANIZATION OF PARAMUTATIONAL COMPONENTS OF THE R LOCUS IN MAIZE. Kermicle, J. L. (Wisconsin Univ., Madison (USA)). 1973. Contract AT(11-1)-1300. 20p. (CONF-730643-5). Dep. NTIS $4.00.

From symposium on basic mechanisms in plant morphogenesis; Upton, New York, USA (4 Jun 1973).

Paramutation is a heritable change resulting from an interaction between alleles in the somatic cells of appropriate heterozygotes. Brink first used this term for the marked reduction in anthocyanin pigmenting effect in maize aleurone of one class of R-locus alleles observed following removal, by meiotic segregation, from heterozygotes involving a second allelic class. The direction of change is predictable and frequency of the alteration may approach 100 percent, thereby distinguishing the phenomenon from mutation. Members of the R allelic series that are subject to alterations of this kind are said to be paramutable, whereas those capable of inciting the change are termed paramutagenic. The salient observations from paramutation studies have been summarized in a general article by Brink. Focus in the present report is on the genetic organization of R paramutational components. (auth)

2686 (COO-3140-33(Suppl.)) NICKEL. Sunderman, F. W. Jr. (Connecticut Univ., Storrs (USA)). 1 Aug 1974. Contract AT(11-1)-3140. 440p. Dep. NTIS $25.00.

Results of a study of the biologic effects of nickel are presented. A balanced and comprehensive survey of nickel in relation to health for the information of the scientific community and the general public and for the guidance of standard-setting and regulatory agencies is included. The sources of nickel, its physical and chemical nature, its measurement, its relation to other pollutants, its biologic effects and margins of safety and dose-response relations (if known) are described. Recommendations are offered for monitoring and controlling nickel in the environment and for further research. (auth)

2687 (COO-3326-30) ELECTRON TRANSPORT IN PHOTOSYSTEM II. Kok, B.; Radmer, R.; Fowler, C. F. (Martin Marietta Labs., Baltimore, Md. (USA)). [nd]. Contract AT(11-1)-3326. 11p. (CONF-740946-1). Dep. NTIS $4.00.

From 3rd international congress on photosynthesis; Rehovot, Israel (2 Sep 1974).

Electron transport in fresh and aged spinach chloroplasts was studied. Experiments were performed to show equal abundance of System I and System II traps and lost equivalents between Systems I and II. The main hypothesis presented is that the homogeneity of "C" is not required. Whether "C" is identical with cytochrome b-559 is discussed. The observation that b-559 is photooxidized at liquid nitrogen temperature implied an intimate association with the primary photooxidant of System II. It is assumed that this path operates at room temperature and is involved in the slow deactivation. The hypothesis that deactivation occurs exclusively via P608, presumably oxidized chlorophyll, may help explain the emission of delayed light by System II. (MCW)

2688 (FMI-1000-552) COMPUTER ORIENTED ANALYSIS OF HUMAN CHROMOSOMES. V. A Case of Chronic Myelogenous Leukemia. Mayall, B. H.; Carrano, A. V.; Rowley, J. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.; Franklin McLean Memorial Research Inst., Chicago, Ill. (USA)). 13 May 1974. 22p. (CONF-740347-1; UCRL-75690). Dep. NTIS $4.25.

From 6th annual symposium on advanced analytical concepts; Oak Ridge, Tennessee, USA (14 Mar 1974).

The DNA-stain content of human metaphase chromosomes was measured using quantitative cytochemistry, scanning cytophotometry, image processing techniques, and computer data processing. This approach was applied to chromosomes from a female with chronic myelogenous leukemia. (CH)

2689 (LA-UR-74-1174) RECENT DEVELOPMENTS IN DISEASE SURVEILLANCE METHODS FOR POULTRY. Hensley, J. C.; Cram, L. S.; Saunders, G. C.; Holm, D. M. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 19p. (CONF-740835-1). Dep. NTIS $4.00.

From U. S. Natural Resources Program meeting; New Orleans, Louisiana, USA (12 Aug 1974).

An interagency developmental activity at the Los Alamos Scientific Laboratory seeks application of physical sciences technology to disease detection and surveillance. High speed and sensitive serological methods and unique methods for virus differentiation by study of single cell effects promise rapid and automated disease screening. Electronic surveillance methods for temperature sensing and identification can offer disease control procedures now impossible. Application of this technology, much of which was not available as few as five years ago, can bring about revolutionary conceptual changes in disease detection and surveillance. (auth)

2690 (LF-tr-95) ULTRASTRUCTURAL DEMONSTRATION OF POLYSACCARIDES WITH CERTAIN ACIDS IN THE SURFACE FILM OF PULMONARY ALVEOLUS. Kalifat, S.; Dupuy-Coin, A. M.; Delarue, J. Translated from J. Ultrastruct. Res.; 32: 572-589(1970). 17p. Dep. NTIS $4.00.

Using several ultrastructural cytochemical techniques, the neutral and acidic polysaccharides in the normal and emphysematous lungs of man and animals have been demonstrated. (ERB)

2691 (ORNL-TM-4659) PILOT PLANT FOR SEWAGE TREATMENT BY CROSS-FLOW FILTRATION. Perona, J. J.; Hutchins, J. D.; Rom, A. M.; Johnson, J. S. Jr.; Sisson, W. G. (Oak Ridge National Lab., Tenn. (USA)). Oct 1974. Contract W-7405-eng-26. 23p. Dep. NTIS $4.25.

A pilot plant was designed and constructed for the treatment of 10,000 gal of sewage per day by the cross-flow filtration process. The process consists of acidification of pH 3 and addition of iron, holdup with air sparging for 1 h, pH adjustment to 6, and filtration. A series of five runs was made successfully; the product fluxes were above 100 gal/day · ft^2 for the first 50 h of operation, and the product quality was good. Chemical and power costs for a large-scale process are in the range 35¢ to 60¢/kgal. The present filter design would not be suitable for a large-scale plant; thus a filter development program is required to advance the process. (auth)

2692 (RISO-M-1736) COMPUTER-AIDED DIAGNOSIS: RESULTS OF A LITERATURE SURVEY OF MEDICAL APPLICATIONS. Goodstein, L. P. (Danish Atomic Energy Commission, Risoe. Research Establishment). Aug 1974. 22p. Dep. NTIS (US Sales Only) $4.25.

This report is the result of a non-exhaustive study of the literature on computer-aided diagnosis in medicine and related fields with the intent of finding methods and techniques which potentially could be useful and applicable as part of a computer-based support system for the control room operator of a modern power station or chemical plant. Earlier Risø studies have proposed a model of the operator as a system component and this report attempts to fit examples of computerized diagnostic aids culled from the literature to particular operator tasks and/or plant situations discussed in these studies. (auth)

2693 (SU-326-P-33-X-3) MUTATION RATES AND MUTATIONAL LOADS IN MAN. Annual Progress Report of Scientific Activity, October 1, 1973–September 30, 1974. Cavalli-Sforza, L. L. (Stanford Univ., Calif. (USA). Dept. of Genetics). 18 Jan 1974. Contract AT(04-3)-326. 6p. Dep. NTIS $4.00.

Sex ratio data and parish book data were analyzed as possible methods of estimating sex-linked recessive lethals. Consanguineous marriages were studied as a function of distance and gene frequency data was analyzed for some recessive diseases in relation to ethnic variation. Tree analysis of 35 human populations for 58 alleles was carried out to test the existence of a pattern in the matrix of variances and covariances of populations corresponding to the expected if drift is important. (ERB)

Materials

2694 (BDX-613-1083(Rev.)) EFFECTS OF REAMING VARIABLES ON BURR PROPERTIES. Gillespie, L. K. (Bendix Corp., Kansas City, Mo. (USA)). Sep 1974. Contract AT(29-1)-613. 33p. Dep. NTIS $4.00.

Component parts of small mechanisms have typically required near-sharp edges to assure reliable component operation: a burr-free condition is needed to minimize possible electrical and mechanical jamming of the mechanism if burrs should break loose during operation. In the past, reliable removal of machining burrs, combined with protection of the near-sharp edge requirements, has dictated that deburring be done only by hand, which is time consuming and inherently operator variable. The repeatability of burr removal and the time required for removal are directly related to burr size: small burrs are easily removed by many deburring processes. The investigation showed that the amount of stock removed by the reamer, and the reamer geometry, are the two most significant variables influencing burr size. Feedrate has little effect on burr length or thickness. Burrs in brass workpieces were found noticeably shorter than those in 303 Se stainless steel and aluminum, while stainless steel tended to have slightly thicker burrs than aluminum or brass. Typical reaming burrs were 0.0005 inch thick by 0.003 inch long. Equations for predicting burr size produced by reaming were prepared. The information gathered in this study will be combined with similar data from other machining operations to determine optimum fabrication conditions. (auth)

2695 (BDX-613-1105(Rev.)) ALUMINUM ETCHANT STUDIES. Knopf, W. H. (Bendix Corp., Kansas City, Mo. (USA)). Sep 1974. Contract AT(29-1)-613. 13p. Dep. NTIS $4.00.

Study of creating precision patterns in thin films involves etching 0.00045-inch-thick (11.43 μm) aluminum. Presently, the absolute measurements of etched element widths cannot be made to closer than ±0.0003 inch (7.62 μm) because the element edge is not a straight line. The measurement uncertainty is a result of the present etchant acting on the aluminum and creating a rough edge. An investigation was initiated to develop an etchant that would result in a smoother, more consistent edge. The approach taken to develop an improved etchant was to test as many different chemicals and chemical combinations as possible that have the ability to etch aluminum at a reasonable temperature and in a reasonable time. Aluminum panels coated with photoresist and exposed with test patterns were etched with different solutions. Evaluation of each etchant was made by photographing an etched edge at 285X and comparing it with one etched in the etchant. (auth)

2696 (BDX-613-1169) AUTOMATIC MACHINE APPLICATION OF SOLID FILM LUBRICATION. Miller, G. P. (Bendix Corp., Kansas City, Mo. (USA)). Sep 1974. Contract AT(29-1)-613. 11p. Dep. NTIS $4.00.

An automatic machine was fabricated and initially evaluated to apply lubricants within narrow tolerances. The machine employs a turntable with ten stations which rotate independently of the turntable; a control panel; a mixing pot; and a spray nozzle. Using Electrofilm 4396 diluted with dioxane, 65 runs of ten samples each were coated. The anticipated thickness was achieved on 92.3 percent of the coated samples. The lubricant thickness varied 0.0001 inch (2.54 μm) or less on 52 of the 65 runs, and the maximum variation for all runs was 0.00022 (5.59 μm). (auth)

2697 (BDX-613-1199(Rev.)) HIGH-DENSITY POLYSTYRENE BEAD PREPARATION. Rice, D. L. (Bendix Corp., Kansas City, Mo. (USA)). Sep 1974. Contract AT(29-1)-613. 16p. Dep. NTIS $4.00.

Techniques were investigated for material preparation required prior to molding high-density polystyrene bead foam. Steam-heated pre-expanders, available from a previous project, were used to provide material throughout the required density range. The use of stabilization ovens was established as a means of accelerating the depletion of pentane to provide the low volatile content required. The capacity of the mixing-weighing system presents a potential limitation in the molding of large, high-density parts. (auth)

2698 (CEA-R-4596) INTERFACIAL STRUCTURES: THERMODYNAMICAL AND EXPERIMENTAL STUDIES OF THE INTERFACIAL MASS TRANSFER. Morel, J. E. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Biologie). Sep 1974. 87p. (In French). Dep. NTIS (US Sales Only) $7.50.

Thesis.

Hypotheses are presented concerning the structure of the interfacial regions between two immiscible liquid phases. It appears that the longitudinal structure is comparable with that of a crystallized solid and that the transversal structure is nearest to that of a liquid. A thermodynamical treatment of the irreversible phenomena in the interfacial region is presented. The equation of evolution of a system consisting of two immiscible liquid phases are deduced. An experimental verification of the theoretical relations is made and the appearance of a great interfacial resistance that slows down the interfacial mass transfer occurs. (tr-auth)

2699 (CONF-740942-1) GEOCHEMICAL APPLICATIONS OF ELECTRON MAGNETIC RESONANCE SPECTROSCOPY. Weeks, R. A.; Griscom, D. L.; Bell, P. M. (Oak Ridge National Lab., Tenn. (USA)). 1974. 10p. Dep. NTIS $4.00.

From 18th ampere congress; Nottingham, UK (9 Sep 1974).

Some of the similarities in the ferromagnetic resonance spectra of terrestrial basalts, lunar soils, and synthetic materials containing magnetic ferric oxide particles are discussed. Optical and electron paramagnetic resonance spectral components of a synthetic glass with a composition similar to an Apollo 17 glass are due to Ti^{3+}, and their intensities increase with decreasing oxygen pressure. Corresponding spectra of the Apollo 17 glass do not contain components due to Ti^{3+}. (auth)

2700 (IS-T-639) STUDY OF THE EFFECT OF COHERENT PRECIPITATES ON THE SURFACE TOPOGRAPHY PRODUCED BY DEFORMATION OF COPPER–2 wt. % COBALT ALLOY SINGLE CRYSTALS. Sinha, U. K. (Ames Lab., Iowa (USA)). Oct 1974. 100p. Dep. NTIS $5.45.

Thesis.

Copper–2 wt. % cobalt alloy single crystals, solution treated and aged, contain precipitates of 90% Co and 10% Cu in a copper matrix. The precipitates are spherical in shape and coherent with the matrix, and their size depends upon the temperature and time of aging. The hardening of this alloy has been largely attributed to the coherency strain. Surface topology was used as the prime method of establishing further data and behavior trends which will help complete the overall picture of the precipitation hardening mechanism and its effects in this alloy system. Single crystals of the alloy were grown in the easy glide orientation. The crystals were solution treated and aged for various lengths of time in order to get different sizes of precipitate particles. A magnetic method was employed to determine the average particle size and the volume fraction of the precipitate. The crystals were successively compressed to approximately 0.3 glide strain and a thorough study of the slip-band step-heights, their separation, and the active slip systems was made after each compression. Interference microscopy was used extensively to measure directly and quantitatively the slip-band step-heights. (auth)

2701 (IS-T-640) STRAIN DISTRIBUTION IN HOT ROLLED ALUMINUM BY PHOTOPLASTIC ANALYSIS. Oyinlola, A. K. (Ames Lab., Iowa (USA)). Oct 1974. 75p. Dep. NTIS $5.45.

Thesis.

A previously developed photomechanic material, Laminac, which excellently simulates the behavior of aluminum in tension was investigated intensively as a possible modeling material for hot-rolled aluminum billets. Photoplasticity techniques combined with the Moiré method were used to study the behavior of the Laminac mixture in compression. Photoplastic analysis revealed that a Laminac mixture of 60% flexible and 40% rigid resins, compressed or rolled at 40°C, showed the phenomenon of double bulging that was observed in hot-rolled aluminum billets. The potentiality of the 60:40 Laminac mixture as a possible simu-

lating material at 40°C is further enhanced by the fact that the true stress-true strain curves of cylindrical samples compressed at 40°C correlated very well with true stress-true strain of identical cylindrical samples of aluminum compressed at 300, 425, and 500°C. (auth)

2702 (MHSMP-74-20-I) ANALYSIS OF TOULENE BY GAS CHROMATOGRAPHY, APRIL–JUNE 1974. Sandoval, J. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 6p. Dep. NTIS $4.00.

Toluene is one of the better dissolution agents for TCTNB; consequently, it is employed as a solvent during the amination of TCTNB into TATB. However, unless high grade toluene is employed an inferior TATB is obtained. The need for the rapid evaluation of toluene prompted the study which resulted in the development of a gas chromatographic column system capable of separating impurities most likely found in toluene. The instrument employed in this endeavor was the Tracor Inc., MT-150 Series chromatograph equipped with dual hydrogen flame ionization detectors, a Westronics MT-21 strip chart recorder and an Infotronics Model CRS-100 integrator. A procedure is described for the rapid analysis of toluene through gas chromatography. (auth)

2703 (MHSMP-74-20-M) X-RAY DIFFRACTION, APRIL–JUNE 1974. Blair, C. C. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 11p. Dep. NTIS $4.00.

X-ray diffraction information about some of the materials associated with TATB is tabulated. The diffraction information and indexing of 1,3,5-trichlorobenzene, the diffraction lines observed from the trichlorotrinitrobenzene used in preparing TATB and the diffraction lines obtained from trichlorodinitrobenzene which is a possible impurity produced in the TATB process are shown. (MCW)

2704 (MHSMP-74-20-O) THERMAL PROPERTIES OF TATB, APRIL–JUNE 1974. Myers, L. C. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 20p. Dep. NTIS $4.00.

TATB has been tested in the chemical reactivity with many other materials and these data are given. These tests were conducted to meet Pantex's safety requirements and to determine if the chemical reactivity test could be used to evaluate the compatibility of TATB with other materials. Metnylene diamine was the only sample that gave an indication of being reactive with TATB. Several thermal analysis tests have been run to characterize TATB. These tests include TMA, DSC, TA, high temperature DTA, and EGA/MS. (auth)

2705 (MHSMP-74-20-Q) PRESSING OF TATB FORMULATIONS. Period Covered: April–June 1974. Harrell, J. D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 4p. Dep. NTIS $4.00.

Experimental formulations of triaminonitrobenzene (TATB) have been pressed into small billets. Characteristics of the billets are described. (auth)

2706 (MHSMP-74-20-R) SLOW PBX AND PLANE WAVE LENS DEVELOPMENT. Period Covered: April–June 1974. Crutchmer, J. A. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 12p. Dep. NTIS $4.00.

Twenty-six billets of Comp. B-3 and baratol were pressed for fabrication into plane wave lenses. Four units of the 20.32 cm (8-inch) diameter plane wave lens, P/081 Mod I-E, were fired and analyzed. The lens design uses Comp. B-3 as the fast component and 76/24 BN/TNT baratol as the slow component. Four units of the P/081 Mod II-B lens design and three units of the 10.16 cm (4-inch) diameter P/040 Mod III-E and Mod III-F lenses were fired and analyzed. These lenses used PBX 9404 as the fast component and 85/15 BN/TNT baratol as the slow component. (auth)

2707 (MHSMP-74-20-S) SENSITIVITY AND PERFORMANCE TESTING OF HIGH EXPLOSIVES. Period Covered: April–June 1974. Kramer, P. E. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). Contract DA-11-173-AMC-487(A). 5p. Dep. NTIS $4.00.

Attempts to measure C-J pressure via the detonation electric effect continued. A wedge test was conducted on paste explosive (PEX) with improved results. Attempts to isolate noise problems in DEE monitoring of wedge tests were not successful. An accurate measurement of the internal magnification of the Pantex Model 101 streak camera was made. Further work was done on measuring detonation velocity and critical thickness of sprayable HE formulations. Impact sensitivity tests were conducted on production lots of HNAB. (auth)

2708 (MHSMP-74-30) PARTICLE CHARACTERIZATION OF RDX–MDF FROM SANDIA SCANNING ELECTRON MICROGRAPHS. Period Covered: April–June 1974. Duncan, A. A. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. 5p. Dep. NTIS $4.00.

For Sandia Labs., Albuquerque, NM.

Analysis of scanning electron micrographs was completed for various MDF-RDX samples. The results indicate particle size change due to molecular mass transport since specific surface area decreases and void volume increases in areas where particle size increases. (auth)

2709 (ORNL-tr-2847) TEXTURES OF COPPER SINGLE CRYSTALS ROLLED AT ROOM TEMPERATURE AND 77°K. Bauer, R.; Mecking, H.; Luecke, K. Translated by R. G. Mansfield from pp 136-143 of Textures in Research and Practice, Proceedings of the International Symposium, Springer-Verlag, 1969. 6p. Dep. NTIS $4.00.

Textures of copper single crystals with various initial orientations were investigated after rolling up to very high degrees of deformation at room temperature and 77°K. The texture development at various depths from the surface of the crystals was examined. Results were explained by the stress condition in the roll gap. Measurements indicated that the end-orientations developed at the various layers across the thickness of the strip depend on initial orientation and rolling temperature. (auth)

2710 (SAND-74-8003) THERMAL EXPANSIONS OF KOVAR AND CERAMVAR AND SEALS OF THESE MATERIALS TO ALUMINA. Bertolotti, R. L. (Sandia Labs., Livermore, Calif. (USA)). Sep 1974. Contract AT(29-1)-789. 15p. Dep. NTIS $4.00.

Thermal expansions of Ceramvar and Kovar were measured over the range of –180 to +1000°C. These measurements aid in predicting thermal contraction mismatch stresses of Ceramvar- or Kovar-to-alumina seals. These stresses reach a maximum during cool-down from the braze temperature; and it is they, rather than room-temperature residual stresses, which are the limiting factor in sealing. The technique of making moly-manganese seals is reviewed briefly. (auth)

2711 (SGAE-2302) PRECIPITATION OF COPPER IN ALUMINIUM-SILVER CRYSTALS. Hoerl, E. M. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Inst. fuer Metallurgie). Jul 1974. 20p. (ME-58/74).

Precipitation of copper in aluminium-silver crystals was observed by an electron microscopy technique. By annihilation of the precipitates at high temperature an activation energy for the dominating diffusion process was calculated from the velocity of the motion of the edges of the precipitates. This energy amounts to 1.45 ± 0.08 eV and represents approximately the height of the potential wall an atom has to overcome in order to leave a precipitated layer. (auth)

2712 (SLA-74-5125) INITIATION OF ELECTRICAL CONTACT ARCING OBSERVED AT POTENTIALS DOWN TO THE MELTING VOLTAGE. Cuthrell, R. E. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 10p. (CONF-741021-1). Dep. NTIS $4.00.

From 20th annual Holm seminar on electrical contacts; Chicago, Illinois, USA (29 Oct 1974).

Results of low-voltage electrical contact arcing experiments are presented. Visible arcs were initiated at potentials down to but not below, the melting potentials for various metals (0.3 to 1.1 volts), whereas the minimum voltage for arcing has been previously assumed to be 11 to 15 volts. Scanning electron microscope photomicrographs show arc pits, melting, and spattering for contacts arced at these low voltages. Circuits were designed to minimize the inductance, and oscilloscope traces of the arcing potentials were obtained. (auth)

2713 (SLL-74-5006) FLYER PLATE TECHNIQUE FOR QUANTITATIVELY MEASURING THE ADHESION OF PLATED COATINGS UNDER DYNAMIC CONDITIONS. Dini, J. W.; Johnson, H. R.; Jacobson, R. S. (Sandia Labs., Livermore, Calif. (USA)). Aug 1974. Contract AT(29-1)-789. 30p. (CONF-741029-1). Dep. NTIS $4.50.

From properties of electrodeposits symposium; New York, New York, USA (Oct 1974).

A method developed at Sandia Laboratories, Livermore for shock wave testing of materials has also worked quite well for quantitatively assessing the adhesion of deposits plated on various substrates. The procedure consists of utilizing magnetic repulsion to accelerate thin, flat metal flyer plates against substrates under test. Evaluation of nickel, copper, and nickel-cobalt electrodeposits plated on various high-strength stainless steels showed the dynamic test to be more discriminating than conventional static tests. (auth)

2714 (UCRL-Trans-10711) ETCH-FORMING: A SPECIAL ELECTROCHEMICAL PROCESS FOR PRODUCING SHAPED METAL PARTS WITHOUT CUTTING. Stiehr, W. (Translated from Galvanotechnik; 63: No. 3, 151-156(1972). 16p. Dep. NTIS $4.00.

Etch-forming is a chemical method of removing material. Some advantages of the process are low tooling costs for small numbers of articles, no wear of the tools, and no change in the tolerance of the workpieces during the production processes; the process is independent of the material and geometry of the final article; freedom from burrs; no change in mechanical properties and no distortion; and no change in the physical properties. (MCW)

Physics and Engineering

2715 (BDX-613-975(Rev.)) BEAM LEAD TESTING, HANDLING, AND FAILURE ANALYSIS. Final Report. Brown, L. W. (Bendix Corp., Kansas City, Mo. (USA)). Sep 1974. Contract AT(29-1)-613. 64p. Dep. NTIS $6.25.

Testing, handling, and failure analysis processes for beam lead semiconductor devices (BLD) were investigated. Experimental BLD reprobing was successful. Limits on probe force and number of reprobes were established for automatic probe equipment. A TO-5 size test header was developed to perform destructive sample testing and was subsequently used to perform qualification testing on devices for a high volume production program. A repeatable process for removal of BLD from as-etched arrays without moving or harming adjacent devices was established for sample removal on lots of purchased BLD. Special techniques were developed for failure analysis of BLD, including removal from circuit paths, probing loose chips for failure verification, mounting for metallurgical cross sectioning, and mounting for scanning electron microscope studies. (auth)

2716 (BDX-613-1056(Rev.)) BRUSH DEBURRING OF MINIATURE PARTS. Gillespie, L. K. (Bendix Corp., Kansas City, Mo. (USA)). Sep 1974. Contract AT(29-1)-613. 32p. Dep. NTIS $4.00.

Brush deburring can produce burr-free near-sharp edges on some miniature metal components. A maximum edge radius of 0.002 inch (50.8 μm) is possible; a more practical limit is 0.003 inch (76.2 μm) maximum. Radii with tolerances of 0.003 to 0.005 inch (76.2 to 127 μm) are not producible by brush deburring. (auth)

2717 (BDX-613-1076(Rev.)) AUTOMATED VISUAL INSPECTION SYSTEM FOR PRINTED WIRING ASSEMBLIES. Taylor, R. D. (Bendix Corp., Kansas City, Mo. (USA)). Oct 1974. 133p. Dep. NTIS $5.45.

An automatic system was needed to improve speed and reliability for visual inspection of printed circuit boards and electronic wiring assemblies. Visual sensors, computer configurations, programs for fault detection and location, computer software systems, and mechanical indexing systems were evaluated. This study served as the basis for a system recommendation. (auth)

2718 (BDX-613-1122(Rev.)) DEFECT DETECTION IN HIGH-DENSITY BRAIDED SHIELDS. Belarde, E. (Bendix Corp., Kansas City, Mo. (USA)). Oct 1974. Contract AT(29-1)-613. 13p. Dep. NTIS $4.00.

Braided cable shields are being evaluated to ensure adequate protection when the cables are exposed to electromagnetic radiation (EMR) fields. This work is divided into two separate categories. (1) Complete cable coverage helps to provide EMR protection; however, the braid pattern, as well as the braid density, is important. A radiographic method proved satisfactory in this area. (2) Freedom from defects such as those sometimes caused by use or handling is necessary to prevent the cables from picking up extraneous electromagnetic radiation and feeding it to sensitive electronic assemblies. Such defects were successfully located by use of a modified Singer Stoddart Model 500 shielded-enclosure leak-detection system that is often called a sniffer. Although these two systems provided acceptable initial results, other systems are being considered in the interest of the best possible nondestructive inspection methods. Both categories of this work will require additional evaluation before establishing cable-braid nondestructive test procedures that are both reliable and economically feasible. (auth)

2719 (BNL-18912) FORCE CALCULATIONS FOR HYBRID (FERRO-NULLFLUX) LOW-DRAG SYSTEMS. Danby, G. T.; Jackson, J. W.; Powell, J. R. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 4p. (CONF-740552-1). Dep. NTIS $4.00.

From Intermag conference; Toronto, Canada (14 May 1974).

A strong-lift large clearance suspension can be produced using the attraction between superconducting train magnets and iron track sheets. A null flux arrangement of track loops interacting with the same train magnets will yield magnetic lift/drag ratios of several hundred, and can be designed to give whatever degree of inherent stability is desired. As an example, lift forces of two tons per foot of vehicle can be achieved with clearances of six to twelve inches, and inherent restoring forces in any direction can be designed in the range of 0.2 to 1 g per inch. Calculations are made of lift and restoring forces for various track designs taking into account finite edge and permeability effects. Such a system with its high lift, low drag capability would allow the economic high speed transport of freight as well as passengers. Possibilities include transport of bulk materials, piggy-back trucks, and autos with passengers. (auth)

2720 (CONF-740429-1) INDEPENDENT CHECK ON THE VALIDITY OF THE PRESSURE CORRECTION IN INCLUSION GEOTHERMOMETRY, USING HYDROTHERMALLY GROWN QUARTZ. Roedder, E.; Kopp, O. C. (Geological Survey, Reston, VA. (USA); Oak Ridge National Lab., Tenn. (USA)). 1974. 35p. NTIS $4.75.

From international conference on progress in research and applications of electron spectroscopy; Namur, Belgium (16 Apr 1974).

Primary fluid inclusions were studied in synthetic quartz crystals (~1 cm) grown in static thermal gradients from 0.5N CsOH or RbOH at 0.8 to 1.8 kb and 371 to 467°C (partial fill 63.5 to 74.0%). Inclusion homogenization temperatures (T_H) were determined, corrected for known pressure to yield trapping temperatures (T_T), and compared with laboratory growth temperatures (T_G) in order to evaluate the validity of inclusion thermometry when pressure corrections (ΔTp) are large. The difference ΔT ($T_T - T_G$) ranged from only −14 to +25°C, in spite of relatively large values for ΔTp (72 to 170°C). ΔT is the sum of the following possible sources of error, only part of which can be evaluated with any precision: (1) errors in measurement of T_H (probably ~±5°C); (2) errors in calculating ΔTp (probably ~±5°C); (3) other possible sources of error intrinsic to the T_H method, such as bubble surface tension, precipitation on the inclusion walls, trapping of non-representative fluid, etc. (probably <1°C); and (4) errors in measurement and interpolation of T_G in the autoclave at the crystal face. It is believed that (4) is probably the largest single source of error here (estimated ±10°C), and that these data prove that if the pressures (and to a lesser extent, the solution composition) are known adequately, pressure corrections can be large and still permit relatively accurate thermometry by means of inclusions. The errors evaluated are relatively small in comparision to those stemming from the uncertainties of geological depth estimates for natural samples from deep environments. (auth)

2721 (CONF-740837-2) VIBRATIONAL FREQUENCY OF A NONCONDUCTING CHARGED LIQUID DROP. Wong, C. Y.; Tang, H. H. K. (Oak Ridge National Lab., Tenn. (USA)). 1974. 6p. Dep. NTIS $4.00.

From international colloquim on drops and bubbles; Pasadena, California, USA (28 Aug 1974).

The vibration of a non-conducting liquid drop endowed with a surface charge is considered, in supplement to the well-known case of a conducting liquid drop studied by Lord Rayleigh in the last century. It is assumed that there is no charge conduction except by hydrodynamical transport due to the flow motion. It is found that the surface flow is of such a form that the charge again maintains an electrostatic equipotential at the surface of the drop at all instants of the vibrational motion, and the same Rayleigh results is obtained. Thus, the Rayleigh result is applicable to more general classes of liquid drops, irrespective of the conductivity of the liquid in these two limits. (auth)

2722 (IFA-FR-119-1974) NON-LINEARITIES IN HEAT TRANSFER IN BOUNDARY LAYERS. Popescu, C.; Boeriu, S.; Biro, L.; Turcu, I. (Institutul de Fizica Atomica, Bucharest (Romania)). 1974. 20p. (In Rumanian). Dep. NTIS (US Sales Only) $4.00.

A qualitative study is made of the local values of thermal flux in cases of nonlinear heat transfer in boundary layers. Transfer equations are solved by numerical methods for the case of very large Prandtl numbers and for the case of very small Prandtl numbers. (tr-auth)

2723 (IS-T-643) QUADRUPOLE MASS SPECTROMETER FOR THE IDENTIFICATION AND CHARACTERIZATION OF NEUTRAL FRAGMENTS FORMED BY THE INTERACTION OF GASEOUS MOLECULES WITH ELECTRONS. Reecher, J. R. (Ames Lab., Iowa (USA)). Oct 1974. 182p. Dep. NTIS $7.60.

Thesis.

A quadrupole mass spectrometer with a modified ion source and modified ion detection circuitry for identifying and characterizing neutral fragments formed by the interaction of electrons with gaseous molecules is described. The instrument incorporates the capability of automatic scanning and recording of neutral frag-

ment mass spectra and neutral fragment ionization potential and appearance potential curves. The neutral fragment mass spectra of benzene, toluene, o-xylene, m-xylene, p-xylene, mesitylene, pyridine, pyrrole, thiophene, 1,2-^{13}C-3,4,5,6-d_4-benzene, d_8-toluene, 0,0-d_2-toluene, d_1-toluene, and ring-d_5-toluene were measured and compared with their corresponding positive ion mass spectra. Numerous neutral fragment ionization potentials were also measured and compared with available literature values. In addition, the following neutral fragment ionization potentials, for which no literature values were available, were measured and reported: CNH_3 (12.21), C_3NH (11.10), C_2H_2 (9.17), C_2NH_4 (13.2), CSH (7.97), CSH_2 (9.77), C_4H_2 (8.31), C_3NH_3 (13.78, 13.90), C_4D_2 (8.90), C_2SH_2 (8.92), C_5H_5 (8.40), and C_5D_5 (8.00). (auth)

2724 (KFK-2031) CONTRIBUTION TO DETERMINE COST OPTIMAL LIFE TESTS FOR COMPONENTS WITH EXPONENTIALLY DISTRIBUTED LIFE TIMES. Sellinschegg, D. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Systemtechnik und Reaktorphysik). Jul 1974. 56p. (In German). Dep. NTIS (US Sales Only) $6.00.

Thesis.

The determination of cost optimal plans for life tests is reported. Plans of the type (n,∞,r), (n,1,r), (n,∞,T) and (n,1,T) are considered. For drawing statistical inference on the basis of the gathered data, the method of testing hypotheses, interval estimates, and the determination of estimators is used. The work determined a plan in such a way that for an optimal statistical decision procedure the expected experimental cost is as low as possible for a given degree of efficiency for the statistical inference. The investigation is done with a cost model, which considers the investment and operating costs of the test facility, the cost for the component to be tested, and the cost (penalty or bonus) for meeting the specified contract length. (tr-auth)

2725 (KFKI-74-21) STRUCTURE OF LASER-IRRADIATED CHALCOGENIDE FILMS. Hajto, J.; Radnoczy, G. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). Apr 1974. 9p. Dep. NTIS (US Sales Only) 4.00.

Optical switching from the crystalline to the amorphous state has been studied in chalcogenide films producing amorphous spots by the help of 60 nsec pulses of a ruby laser. These amorphous written spots can be erased both by laser and electron beams. Electron-microscopic examination of the films shows that the diameters of the amorphous spots are 0.5 μm. The structural properties of these films depend on their thickness. (auth)

2726 (MHSMP-72-78) ELECTROMAGNETIC STRESS AND VELOCITY GAGES. Period Covered: July–September 1972. Van Velkinburgh, J. H.; Wilson, R. S. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1972. Contract DA-11-173-AMC-487(A). 16p. Dep. NTIS $4.00.

For Sandia Labs., Albuquerque, NM.

The electromagnetic velocity gage technique was shown to be a practical, accurate, and relatively simple method for measuring shock wave profiles from small explosive drivers. The development of the electromagnetic stress gage that is a modified version of the velocity gage is described and records both particle and shock velocities, hence pressure. (MCW)

2727 (MHSMP-74-18) CALIBRATION OF THE PXD-F PRESSURE TRANSDUCER AT 239°K. Period Covered: April–June 1974. Canada, C. E.; Hanes, L. D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. 19p. Dep. NTIS $4.00.

For Sandia Labs., Albuquerque, NM.

A resistance-pressure curve for the PXD-F manganin wire transducer was determined at 239°K. Although Hugoniots of the transducer potting material (alumina-filled epoxy) vary with temperature, the resistance-pressure curve at 239°K is congruent within expected error with previous measurements at 294°K and 347°K but deviates from measurements at 230°K. (auth)

2728 (RISO-M-1693) ANALYSIS OF OPERATOR NEEDS FOR CONTROL ROOM INFORMATION DURING START-UP OF A POWER STATION BOILER. Pedersen, O. M. (Danish Atomic Energy Commission, Risoe. Research Establishment). Mar 1974. 24p. (In Danish). Dep. NTIS (US Sales Only) $4.25.

The control room operator's needs for plant data are investigated for the start-up of a power station boiler. The data are assumed to be presented by computer-controlled display as a replacement for the existing control room instrumentation. Weight was laid on including the operators in the evaluation of the need for data and data presentation. Methods that could effectively support and foster communication with the operators during this evaluation were investigated. (auth)

2729 (SAND-74-0119) DISTRIBUTION FUNCTIONS IN THE STATISTICAL THEORY OF COMPRESSIBLE TURBULENT FLUIDS. Fox, R. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). Sep 1974. Contract AT(29-1)-789. 29p. Dep. NTIS $4.50.

The hierarchy of equations for the multipoint distribution functions is developed for compressible turbulent fluids. (auth)

2730 (SAND-74-0175) FLIGHT MASS SPECTROMETRY AT SANDIA LABORATORIES. Woods, R. O. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1974. Contract AT(29-1)-789. 2½p. Dep. NTIS $4.50.

Sandia Laboratories has an extensive background in the adaptation of mass spectrometers to unusual environments. The purpose of this report is to document that capability and to define it for other possible users. (auth)

2731 (SAND-74-0191) ANALYSIS OF INCOMPRESSIBLE FLOW IN POROUS MEDIA. Shouman, A. R.; Donaldson, A. B. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1974. Contract AT(29-1)-789. 22p. Dep. NTIS $4.25.

The relationship between the various parameters that govern flow through porous media and the basis of the D'Arcy and Forchheimer expressions for these relationships are discussed. Specifically, the nonlinear term in the Forchheimer equation is related to internal expansion and contraction effects and to the entrance and exit effects at the boundary of the specimen. A generalized Forchheimer equation, developed in this paper, is used in conjunction with experimental data for water flow through polyurethane foam to establish its flow characteristics. (auth)

2732 (SAND-74-8212) GAS-TRANSFER ANALYSIS. Section B. Pseudo-Polytropic Expansion of a Perfect Gas. Chenoweth, D. R. (Sandia Labs., Livermore, Calif. (USA)). Sep 1974. Contract AT(29-1)-789. 33p. Dep. NTIS $4.75.

A definition is given of the empirical coefficients n, λ, and C_d, and a gas-transfer theory is formulated in terms of them when they are all time-dependent as well as the minimum flow area A_e. It is shown that it is the local value of the time-average $t^{-1}\int_0^t (\lambda C_d A_e)dt$ that is important in some cases. Explicit results are given for the choked flow case when n is time-dependent but $\lambda C_d A_e$ is constant and also when n is constant but $\lambda C_d A_e$ is time-dependent. It is shown that the limiting cases of an adiabatic ($n = \gamma$) and an isothermal ($n = 1$) supply reservoir are contained in these results. Two measures of the possible effects of coupling of supply reservoir heat transfer with λC_d are described for use with experimental data to determine the extent of validity of two important simplifying assumptions. (auth)

2733 (SLL-73-0071) FINITE DIFFERENCE COMPUTATIONS OF THE DYNAMIC MOTION OF CYLINDRICAL SHELLS INCLUDING THE EFFECT OF ROTATORY INERTIA. Emery, A. F.; Cupps, F. J. (Sandia Labs., Livermore, Calif. (USA)). Oct 1974. Contract AT(29-1)-789. 53p. Dep. NTIS $5.75.

A study was made of the accuracy of several finite difference methods for computing the dynamic motion of cylindrical shells. Wave speeds, dispersion effects, and truncation errors have been evaluated by comparing the results of the finite difference and Fourier series solutions using Filigge's shell theory and the transverse shell and rotatory inertia theory. The finite difference models used algorithms based upon the differential equations and upon the conservation equations, with the latter results shown to be less sensitive to the mesh size and in better agreement with the Fourier series results. A frequency analysis of all the algorithms and the Fourier series demonstrated that finite difference spectra had a very considerable gap that slowly closed as the mesh size decreased, with the spectra being most complete for the better algorithm. A new algorithm was based upon these spectra and is shown to yield good results while permitting increases in the computing speeds by the factor mesh size/shell thickness. (auth)

2734 (SLL-74-0023) GNATS: A FINITE ELEMENT COMPUTER PROGRAM FOR THE GENERAL NONLINEAR ANALYSIS OF TWO-DIMENSIONAL STRUCTURES. Young, R. C.; Callabresi, M. L. (Sandia Labs., Livermore, Calif. (USA)). Oct 1974. Contract AT(29-1)-789. 102p. Dep. NTIS $8.25.

GNATS is a system of three user-orientated finite element computer programs designed for the nonlinear analysis of axisymmetric and two-dimensional static structures. A preprocessor program, MESH2, provides the two-dimensional finite element mesh. The main program, GNATS, solves the nonlinear structural problem, including the effects of large displacements, large strains, and elastic-plastic material behavior. A Lagrangian coordinate system is used in GNATS for describing the equilibrium configuration of the body. A postprocessor program, GPRINT, prints the selected values of displacements, stresses, and strains. The input data required for using MESH2, GNATS, and GPRINT for a nonlinear structural

analysis is described. Dynamic dimensions were used for all arrays in these programs. The maximum problem size, therefore, is limited only by the computer being used. All input data from cards is specified in a free-field format and may be assembled into the data decks in any order. (auth)

2735 (SLL-74-0217) COMPARISON OF A HYBRID PARACHUTE SYSTEM TO CONVENTIONAL PARACHUTE SYSTEMS FOR LAYDOWN DELIVERY OF A BOMB. Rychnovsky, R. E. (Sandia Labs., Livermore, Calif. (USA)). Sep 1974. Contract AT(29-1)-789. 20p. Dep. NTIS $4.00.

An analytical study has been made to compare the impact conditions for a bomb using three types of parachutes: a hybrid parachute, a conventional staged two parachute system, and a single stage ribbon parachute. The comparison was made for laydown delivery of a 2406-pound bomb released from an altitude of 100 feet. The same parachute weight and pack volume was allowed for each of the three parachute systems. Possible variations in the timing of the deployment and parachute opening sequence and variation in the effective drag areas of the parachutes were considered. The hybrid parachute would provide the lowest impact velocity and highest impact angle of any of the systems considered. It could be delivered from low altitudes, but would not reach its terminal velocity nor have a high impact angle from a 100-foot release altitude. (auth)

2736 (TID-26632) STRATOSPHERIC FLOW AND SOLAR VARIABILITY. Atmospheric Science Paper No. 223. Macdonald, B. C. (Colorado State Univ., Fort Collins (USA). Dept. of Atmospheric Science). Apr 1974. Contract AT(11-1)-1340. 78p. Dep. NTIS $7.00.

Thesis.

A brief summary of recent research relating solar variability to weather elements on earth is presented. A response of stratospheric flow associated with the polar night vortex to this variability is determined beginning three to five days after the occurrence of a geomagnetic storm. The contour gradient at the 10 millibar surface near the edge of this vortex steepens, and the flow near the edge becomes more meridional. Warmings detected at this level tend to propagate downward. The reaction of the polar vortex flow seems to be most marked when the flow is nearly unstable. Some mechanisms presented by other workers in this field as well as the implications of these findings are discussed. (auth)

2737 (UCID-15041) INITIAL CURRENT RESPONSE OF A TAPE WOUND CORE TO AN APPLIED VOLTAGE PULSE. Winter, S. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Oct 1966. Contract W-7405-eng-48. 5p. Dep. NTIS $4.00.

When tape wound magnetic cores are driven by a step voltage pulse the resulting current pulse starts with a step response. The height of the current step was measured at voltages from 500 V to 3 kV on a number of cores of different sizes and with tape thicknesses of ½ and 1 mil. Results show that the initial step in current is a manifestation of a surface phenomenon. (MCW)

2738 (UCID-15042) MAGNETIZATION OF TAPE ASSUMING UNIFORM DISTRIBUTION OF NUCLEATING CENTERS THROUGHOUT THE TAPE. Winter, S. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Nov 1966. Contract W-7405-eng-48. 14p. Dep. NTIS $4.00.

The saturation wave analysis of tape-wound magnetic cores agrees well with experimental data in its predictions of current values during the latter half of a pulse. During the first part of the pulse the theory and experimental data differ. From this theory, the prediction is made that for an applied step-voltage pulse the current response should rise linearly from zero throughout most of the pulse whereas experimentally, the current starts with a step response, levels off, and then rises linearly. The reason for these discrepancies is believed to be in the assumptions that a Bloch wall was created instantly and that the wall would move inward when the magnetic field strength at the wall was zero. The analysis attempts to determine, at least qualitatively, how nucleating centers of reverse magnetization might grow and what their effect would be on the current pulse, thereby providing a better understanding of the initial part of the current response. (auth)

2739 (UCID-16573(Rev.1)) LLL TRANSIENT ELECTROMAGNETIC MEASUREMENT FACILITY: A BRIEF DESCRIPTION. Anderson, R. A.; Landt, J. A.; Deadrick, F. J.; Miller, E. K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Aug 1974. Contract W-7405-eng-48. 15p. Dep. NTIS $4.00.

Advances in sub-nanosecond pulse generation and sampling technology have provided the electromagnetic engineer the use of pulse techniques for various antenna and scattering measurements. The data is obtained in the time domain and converted to broad band frequency domain information by the use of the Fast Fourier Transform. The transient EM measurement facility at LLL is described. Measurements are obtained in the time interval from the time of incident pulse to time of arrival of the first reflection. This time interval is determined by the size of the ground plane and the length of infinite radiating source. In frequency domain terms, this time interval determines the low frequency cut-off. For the LLL facility the cut-off frequency is 50 MHz and can be extended by simple experiment modifications and data processing. The upper frequency cut-off is determined by the measuring equipment bandwidth. In this facility the upper frequency cut-off is about 3 GHz, which can be extended to 10 GHz by additional data processing. (MCW)

2740 (UCID-16584) MAGNETIC PROBES AS PARTICLE VELOCITY DETECTORS. Hayes, B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Sep 1974. Contract W-7405-eng-48. 20p. Dep. NTIS $4.00.

Two types of magnetic probes, the stirrup and axially-symmetric magnetic (ASM) probes, are examined for measuring particle velocity in detonation products. Although the stirrup probe is simple in operation and provides voltage data relatively easy to translate into velocity, it has serious electrical noise limitations. The ASM-probe is more complex and provides data more difficult to translate, but does not have the noise problems associated with the stirrup probe. It is indicated that the ASM-probe is the more effective detector of particle velocity. (auth)

2741 (UCRL-75192) SIMULATIONS, PERTURBATIONS, AND INTERPRETATIONS. Chang, J. S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1974. 42p. (CONF-740232-2). Dep. NTIS $5.25.

From 3rd conference on CIAP; Boston, Massachusetts, USA (26 Feb 1974).

Directly and indirectly the Climate Impact Assessment Program has stimulated the development of many so-called parameterized transport and chemical kinetics models of the stratosphere. Due to the variety of parameters involved it has become necessary to understand and evaluate the possible implications of their quantifications. This is especially important since these models may constitute the major input to the study of the perturbational effect on the stratosphere from stratospheric vehicle operations. Given present understanding of these models, the parameterization of various physical processes simulated by the models, the perturbational studies with these models, and the restrictions on the interpretations of simulation results are analyzed. (auth)

2742 (UCRL-76043) AMPLIFIER THEORY. Hopf, F. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Sep 1974. 28p. Dep. NTIS $4.50.

It is shown how the two-level atom theory is modified to treat the situation presented by amplification on rotational-vibrational transitions in molecules. Several differences of minor consequences in the amplifier exist between molecular and electronic transitions. The important difference is that the rotational collisions in molecules occur very rapidly, $\sim T_2$. Pressure-broadened operation usually occurs in practical applications (pressure ≥ 10 Torr), and one cannot consider pulses that are of the order of T_2 without considering rotational effects. The CO_2 transition of 001 → 100 is shown. The energy is initially stored in the upper vibrational rotational states. As the energy is extracted from the single lasing level, the rotational levels repopulate the active state via rapid collisions and appear in the equations in the form of a pump term. Since there is only a finite amount of energy in the rotational states, the pump can saturate. The mathematical analysis suggests that the experiment depends on chemical pump processes without substantial alteration due to rotational kinetics. Short-pulse amplication in CO is briefly evaluated. (MCW)

Appendix 1

SCOPE AND SECTION ARRANGEMENT OF NUCLEAR SCIENCE ABSTRACTS

Introduction

This publication defines the subject scope and arrangement of the literature in *Nuclear Science Abstracts (NSA)*. Broadly stated, the subject scope of *NSA* includes all of nuclear science and technology defined as follows:

> Nuclear science is the study of the production, properties, and phenomena of atomic nuclei, subatomic particles, and nuclear radiation.
>
> Nuclear technology is the application of nuclear science to other sciences and engineering, and conversely, the application of other sciences and engineering to the problems of nuclear science.

Part 1 identifies the major fields of nuclear science and technology into which *NSA* is divided. Subdivisions are listed under each field. Each subdivision is followed by statements of specific subject interest. These statements have been prepared to show the exact range and limits of subject interest for selecting literature abstracted and indexed in *NSA*.

Part 2 identifies the extent of interest in the chemical elements.

An index to Part 1 begins on page 23.

NSA covers reports, journals, books, patents, reviews, theses, conferences, and other similar literature. Selection is based on subject content; nothing is excluded solely on the basis of form, origin, or language. Some of the general practices followed in selecting literature for *NSA* are as follows:

1. Popular type articles are not included.
2. Textbooks below the graduate level are not included.
3. Theses below the doctoral level are not included.
4. Patents that have been filed in several countries are included only once.
5. Material existing only as abstracts or short summaries is not included except for papers summarized in the *Transactions of the American Nuclear Society*.
6. Material initially published in a language other than English may be included both when an item is published in the original language and when an item appears in an English language translation.
7. All U. S. Atomic Energy Commission research and development reports in printed form which have been made publicly available at the National Technical Information Service (NTIS) are included in *NSA*. Also included in *NSA* are the printed reports from the national nuclear energy organizations of the United Kingdom, Japan, Canada, Sweden, Denmark, Norway, Australia, and France which have been made publicly available at NTIS.
8. Related groups of engineering drawings and specifications are abstracted and indexed in *NSA* when they become publicly available.
9. As a general practice, material more than two years old is not included in *NSA*.

All journals scanned regularly are listed annually in Issue No. 1 of odd numbered volumes. New additions are listed in issue 1 of even numbered volumes.

Part 1

SCOPE AND ARRANGEMENT OF NSA
(Numbers in parenthesis are for retrieval purposes)

CHEMISTRY (40.000)

Analytical and Separations Chemistry (40.100)

[Analytical chemistry of isotopes, transactinides, actinides, lanthanides, Be, Cs, I, Kr, Mo, Nb, Pm, Rn, Ra, Ru, Sc, Sr, Ta, Tc, Te, Xe, Y, Zr, or any element or compound if the application is directly associated with nuclear technology. Analyses to determine reactor fuel burnup; burnup calculations are included under REACTOR TECHNOLOGY. Arrangement is according to analytical procedure. Information relative to analytical methods is included as indicated.]

Activation and Nuclear Reaction Procedures (40.110)

The subject in general or descriptions of the method.

Chemical and Spectral Procedures (40.120)

Radiometric and Radiochemical Procedures (40.130)

Nuclear radiometric or radiochemical procedure, including properties of radioisotopes as sources in x-ray analyses. Routine tracer studies are excluded.

Separation Procedures (40.140)

Separation procedures for transactinides, actinides, lanthanides, Be, Cs, I, Kr, Mo, Nb, Pm, Rn, Ra, Ru, Sc, Sr, Ta, Tc, Te, Xe, Y, Zr, and any material of interest in nuclear technology except the procedures covered elsewhere, e.g., under Activation Procedures, Reactor Fuel Reprocessing, and Radioactive Waste Treatment.

Inorganic, Organic, and Physical Chemistry (40.200)

Chemical and Physicochemical Properties (40.210)

Chemical and physicochemical properties of nonradioactive elements, compounds, or mixtures directly associated with nuclear technology. Also includes the preparation of radioprotective compounds.

Isotope Effects (40.220)

Isotope effects on nonnuclear chemical and physical properties. Isotope effects are excluded when used only as a tool in the analysis of reaction mechanisms or in structure studies.

Isotope Exchange and Isotope Separation (40.230)

Isotope exchange if the exchange is of primary concern or the exchange mechanism is used in isotope separation.

Chemical and physicochemical isotope separations are included here; but industrial scale processes such as gaseous diffusion and centrifugation are included under ISOTOPE AND RADIATION SOURCE TECHNOLOGY. Radioisotope production is included under Radiochemistry and Nuclear Chemistry.

Feed Materials Processing (40.240)

Chemical processing of ores for recovery of uranium or thorium, including all extraction, conversion, or reduction steps. Also includes chemical engineering of plants for such processing, but site surveys and environmental impact are included under ENVIRONMENTAL AND EARTH SCIENCES.

Radiation Chemistry (40.300)

[The radiations considered here include accelerated ions, gamma radiation, x radiation, bremsstrahlung, neutrons, protons, alpha particles, beta particles, deuterons, and other subatomic particles. Ultraviolet, infrared, and visible radiations are not included.]

Radiation effects on the chemical and physicochemical properties of any element, compound, or mixture. General papers on solvated electrons and hydroxyl radicals are also included. Radiation effects on the biological activity of biochemicals in vitro or in vivo and all information on radiation effects on biochemicals in living organisms are included under LIFE SCIENCES. Radiation effects on metallurgical or solid state properties are included under MATERIALS or PHYSICS (SOLID STATE).

Radiochemistry and Nuclear Chemistry (40.400)

Radiochemistry and nuclear chemistry are included without restrictions except for tracer applications and labeled compound preparation, which are included only if there is a contribution to the technology. Include those items that detail the technology, but exclude those in which no change in methodology is indicated.

Hot-Atom Chemistry (40.410)

Any aspect, including recoil production and reactions.

Properties of Radioactive Materials (40.420)

Chemical and physicochemical properties of radioactive elements or materials, including the stability of labeled compounds and chemical decontamination of surfaces or work areas. Decontamination of reactor vessels following accidents is included under REACTOR TECHNOLOGY.

Radioactive Waste Treatment (40.430)

Radioactive waste processing for concentration, decontamination, or fission product recovery.

Waste disposal monitoring is included under ENVIRONMENTAL AND EARTH SCIENCES; waste disposal is included under NUCLEAR MATERIALS AND WASTE MANAGEMENT.

Radioisotope Production (40.440)

Radioisotope production processes involving chemical separations. Development and uses of radioisotope radiation sources are included under ISOTOPE AND RADIATION SOURCE TECHNOLOGY.

Reactor Fuel Reprocessing (40.450)

Reactor fuel processing, including analytical control, chemical separations, solvent studies, and plant and process design, performance, and operation. Environmental monitoring and impact are included under ENVIRONMENTAL AND EARTH SCIENCES.

CONTROLLED THERMONUCLEAR RESEARCH (70.000)

Plasma and thermonuclear physics, except solid-state plasma, arranged as follows:

Confinement and Heating (70.100)

Diagnostics (70.200)

Kinetics (General) (70.300)

Kinetics (Experimental) (70.400)

Kinetics (Theoretical) (70.500)

Production (70.600)

Stability (70.700)

Thermonuclear Engineering and Equipment (70.800)

Wave Phenomena (70.900)

ENGINEERING (42.000)

Energy Conversion (42.100)

Equipment and methods for the direct conversion of nuclear energy from radioisotopes or fission products into electric energy, e.g., beta-voltaic cells, thermoelectric generators, thermionic converters, cardiac pacemakers, etc. Information on the use of reactors as heat sources for electric energy generation is categorized under REACTOR TECHNOLOGY AND REGULATION. Information on the fabrication, performance testing, and use of radioisotope heat sources is categorized under ISOTOPE AND RADIATION SOURCE TECHNOLOGY.

Facilities and Equipment (42.200)

Design, construction, operation, and applied mechanics studies (stress, strain, motion, vibration, elasticity, deformation, etc.) of nuclear facilities and equipment including components of such facilities and equipment, e.g., irradiation plants, pilot plants, laboratories, etc. Only those facilities and equipment are included here for which a more appropriate category has not been provided. In general, information on facilities and equipment is included under categories more closely related to the purpose of the facility or equipment, e.g., CHEMISTRY, PARTICLE ACCELERATORS, REACTOR TECHNOLOGY AND REGULATION. Remote handling equipment is included under NUCLEAR MATERIALS AND WASTE MANAGEMENT.

Lasers (42.210)

Laser research and development information (not applications). Applications of lasers in isotope separation are included under ISOTOPE AND RADIATION SOURCE TECHNOLOGY and CHEMISTRY. Applications of lasers in fusion plasma production and heating are included under CONTROLLED THERMONUCLEAR RESEARCH.

Cryogenic and Superconducting Equipment and Devices (42.220)

Design, fabrication, performance, and testing of superconducting equipment and devices, e.g., superconducting cables, magnets, generators, etc., or equipment and devices using superconductors or superconducting junctions as a component, e.g., superconducting quantum interference devices (SQUIDS), Josephson junctions, etc. Cryogenic equipment and devices are also included when such equipment and devices are used in applications of superconductivity. Applications of superconductivity in accelerators and fusion reactors are included under PARTICLE ACCELERATORS and CONTROLLED THERMONUCLEAR RESEARCH, respectively. Information on the theory of superfluidity and superconductivity is included under PHYSICS (LOW-TEMPERATURE). Information on superconducting materials is included under MATERIALS.

Heat Transfer and Fluid Flow (42.300)

Heat transfer and fluid flow if nucleate boiling, boiling burnout, critical heat flux, two-phase flow, flow in rod bundles, or liquid metals are considered. Heat transfer or fluid flow applied in nuclear technology is included under sections for the application.

Materials Testing (42.400)

Destructive or nondestructive materials testing if a direct application to nuclear technology is indicated and if categorization on the basis of application would be less appropriate. In general, information on component testing is included under categories more closely related to the component, e.g., information on reactor fuel element testing is included under REACTOR TECHNOLOGY.

The use of radioisotopes and radiation sources in radiographic or radiometric testing is included under ISOTOPE AND RADIATION SOURCE TECHNOLOGY.

Nuclear Explosions (42.500)

Detection of nuclear explosions and civil uses of nuclear explosions, including simulations using non-nuclear explosives.

Protective Structures and Equipment (42.600)

Structures and equipment designed primarily for equipment and personnel protection, e.g., blast and fallout shelters, shielding (except for accelerator and reactor shielding), clean rooms, air filtration systems, fire protection systems, masks, and special clothing. The fabrication of bulk shielding is

included under MATERIALS, shielding calculations are included under PHYSICS (RADIATION AND SHIELDING), and remote-handling equipment is included under NUCLEAR MATERIALS AND WASTE MANAGEMENT.

Safety Engineering (42.700)

Safety at nuclear facilities if no more appropriate category is provided. In general, safety engineering information is included under categories for specific activities or facilities, e.g., Nuclear Explosions or REACTOR TECHNOLOGY.

Vacuum Engineering (42.800)

Ultrahigh (10^{-9} torr or greater) vacuum systems and equipment if no nuclear application is indicated. Applied vacuum engineering is included under categories for the applications, e.g., PARTICLE ACCELERATORS.

ENVIRONMENTAL AND EARTH SCIENCES (44.000)

Minerals and Ores (44.100)

Identification, properties, prospecting, mining, and estimated reserves of thorium and uranium minerals and ores (including equipment). Chemical processing of ores is included under CHEMISTRY.

Radioactive Effluents (44.200)

Concentration or levels of radioactive materials discharged to the natural environment (atmosphere, soil, and waters) under accident or normal operating conditions at nuclear facilities.

Radioactivity Monitoring and Transport (44.300)

Monitoring and/or transport and distribution of radioactive materials (including natural radioactivity) in or through the atmosphere, soil, or waters of the earth. Also includes monitoring and radiation hazards presented by radioactive materials in ecosystems or food cycles. Instrumentation for monitoring radioactivity is included under INSTRUMENTATION.

Radiometric Techniques (44.400)

Use of radioisotopes or radiation sources in investigations of the environment or the earth, e.g., soil and water movement, isotopic methods of geochronology, etc., if the technique is of primary concern or is presented as an advancement of the technology. Instrument design is included under INSTRUMENTATION.

Site Surveys (44.500)

Evaluation and selection of sites for nuclear installations such as fuel fabrication plants, radiochemical processing plants, and nuclear explosions. Seismological and background radiation surveys are included. Ecological studies of sites for nuclear facilities and sites for radiological research are also included. Nuclear power plant siting is included under REACTOR TECHNOLOGY.

Thermal Effluents (44.600)

Characteristics, quantities, and effects of thermal discharges to the atmosphere, soil, or waters of the earth from chemical plants, both fossil- and nuclear-fueled power plants, or any other facility with thermal discharges of the same order of magnitude.

Chemical Effluents (44.700)

Characteristics, quantities and effects of nonradioactive chemical discharges to the atmosphere, soil, or waters of the earth from nuclear facilities such as reactors, gaseous diffusion plants, fuel reprocessing plants, etc. Chemical effluents considered in comparative studies of energy production methods are also included.

INSTRUMENTATION (46.000)

Radiation Detection Instruments (46.100)

Arrangement is as follows:

General Detectors and Monitors
Radiation Dosimeters
Nuclear Spectroscopic Instrumentation
(Includes Moessbauer spectrometers)
High-Energy Physics Instrumentation

Radiometric Instruments (46.200)

Any instrument employing a radiation source and/or radiation detector in its operation.

Radiation Effects on Instrument Components, Instruments, or Electronic Systems (46.300)

Miscellaneous Instruments (46.400)

Limited to instruments, instrument components, or instrumentation systems for application in nuclear technology.

ISOTOPE AND RADIATION SOURCE TECHNOLOGY (47.000)

Isotope Separation (Industrial) (47.100)

Industrial processes for heavy water production, uranium enrichment, or other isotope separation.

Isotopic Power Sources (47.200)

Use of radioisotopes (fission products) as sources of electric, propulsive, or thermal energy.

Radiation Sources (47.300)

Design or fabrication of radiation sources, including neutron sources, but not accelerators or reactors. Use of radiation sources in industrial processes such as food processing, sterilization of medical supplies, polymer production, etc. Basic radiation effects are included under CHEMISTRY or LIFE SCIENCES, but information on radiation effects that influence product acceptability or marketability, such as color or taste, is included here.

LIFE SCIENCES (48.000)

[For this section the term RADIATION is defined as nuclear particles, accelerated electrons and ions, and γ and x radiations. Information on uv effects is included *only* if microorganisms, cells, or biochemicals are the subjects of study. Laser radiation, magnetic fields, microwaves, and sunlight are excluded. The concept of RADIATION EFFECTS includes the effect itself, radiomimetic effects, and any information relating to the effect, e.g., information on assessment, prevention, alteration, transmission, reversal, recovery, etc., and information on the determination or influence of experimental variables such as dose, dose rate, LET, etc. This includes modification of radiation effects by radioprotective or effect-enhancing substances and studies on these substances to establish their independent effects. Theoretical aspects of dose determination or measurement in tissue equivalent materials or phantoms are included under PHYSICS (RADIATION AND SHIELDING).]

Radiation Effects on Biochemicals (48.100)

Effects on biochemicals in living organisms and on their biological activity; information on other effects on biochemicals outside living organisms is included under CHEMISTRY. Also includes the preparation of materials for irradiation and irradiation procedures. The preparation of the radiation sources is included under CHEMISTRY or ISOTOPE AND RADIATION SOURCE TECHNOLOGY.

Radiation Effects on Cells (48.200)

Effects of radiation from external or internal sources on cells in vitro, including cells in cultures; effects on in vivo cells are included in other LIFE SCIENCES categories for entire organisms. Also includes information on the preparation of materials for irradiation and irradiation procedures. The preparation of the radiation sources is included under CHEMISTRY or ISOTOPE AND RADIATION SOURCE TECHNOLOGY.

Radiation Effects on Microorganisms (48.300)

Effects on microorganisms, including bacteria, protozoa, unicellular algae, fungi, and yeasts. Uses of radiation in industrial processes for the radiopreservation of food, radiosterilization of medical supplies, radiation preparation of vaccines, etc., are included under ISOTOPE AND RADIATION SOURCE TECHNOLOGY unless effects on specific organisms are considered.

Radiation Effects on Plants (48.400)

Effects on plants (including multicellular algae and in vivo studies on plant cells), of external-source radiations including the preparation of materials for irradiation and irradiation procedures. The preparation of the radiation sources is included under CHEMISTRY or ISOTOPE AND RADIATION SOURCE TECHNOLOGY. Industrial processes for radiopreservation or disinfestation of foods is under ISOTOPE AND RADIATION SOURCE TECHNOLOGY.

Radiation Effects on Animals (48.500)

Man (48.510)

Effects of external-source or implanted-source radiations on man or on human tissues or cells in vivo. Therapeutic irradiation is included *only* if there is significant information on the effects on normal tissues, if evaluations are made for new radiation sources, e.g., pion beams, or if a contribution is made to the technology. Include those items that detail the technology, but exclude those in which no change in methodology is indicated.

Vertebrates (48.520)

Effects of external-source or implanted-source radiations on vertebrates or on vertebrate tissues or cells in vivo, including the preparation of animals for irradiation and irradiation procedures. The preparation of radiation sources is included under CHEMISTRY or ISOTOPE AND RADIATION SOURCE TECHNOLOGY.

Invertebrates (48.530)

Effects on invertebrates or on invertebrate tissues or cells in vivo, including the preparation of the organism for irradiation and irradiation procedures. The preparation of radiation sources is included under CHEMISTRY or ISOTOPE AND RADIATION SOURCE TECHNOLOGY. Industrial scale processes for pest control and crop disinfestation are included under ISOTOPE AND RADIATION SOURCE TECHNOLOGY unless there is significant information on the effects of radiation on specific organisms.

Radionuclide Effects (Internal Source) (48.600)

[Absorbed or incorporated radioactive materials, not implanted sources, in any in vivo studies.] Internal source evaluation and effects, including experimental procedures, but not the preparation of labeled compounds for administration.

Nuclide Kinetics and Toxicology (48.700)

Kinetics and toxicology of deuterium and radionuclides in or on living organisms. Also includes contamination and decontamination, both internal and external, of living organisms. Levels and movement of radionuclides through man's environment are included under ENVIRONMENTAL AND EARTH SCIENCES.

New Tracer Techniques (48.800)

Use of isotope tracers in LIFE SCIENCES research, e.g., animal husbandry, disease and pest control, ecology, medicine, if a contribution is made to the evaluation and technology of tracer usage. Include those items that detail the technology, but exclude those in which no change in methodology or application is indicated. Also includes extensive bibliographies or reviews.

MATERIALS (50.000)

Corrosion, erosion, surface phenomena, fabrication, phase studies, and properties (including physical, mechanical, electrical, and solid-state) are included with the limitations indicated in the arrangement below.

Radiation damage in or radiation effects on any material are included with the following exceptions:

Radiation effects on biological materials are included under LIFE SCIENCES.

Radiation effects on chemical or physicochemical properties are included under CHEMISTRY.

Ceramics and Cermets (50.100)

Coverage includes the borides, carbides, hydrides, nitrides, and oxides of those elements in Part 2 in which a metallurgy interest is indicated. Any studies of other ceramic or cermet materials supported by a nuclear organization or agency and studies of such materials at cryogenic temperatures are also covered.

Metals and Alloys (50.200)

Coverage includes those elements in Part 2 in which a metallurgy interest is indicated. Also covered are any metals or alloys studied at cryogenic temperatures and superconducting metals. Any other metals studies, such as steels, supported by a nuclear organization or agency are covered.

Other Materials (50.300)

Largely limited to materials applied or specifically for application in nuclear technology, e.g., carbon, graphite, concretes, plastics; but also includes any nonmetallic superconducting material or material, such as insulators, applied at cryogenic temperatures.

NUCLEAR MATERIALS AND WASTE MANAGEMENT (52.000)

Equipment, methods, standards, and systems, for safeguarding and management of materials of nuclear interest, e.g., fissionable materials, radioactive materials, radioactive wastes, or materials of special interest such as heavy water. The arrangement is as follows:

Accountability and Safeguards (52.100)

Research and development on equipment, methods, and systems to guard against the diversion of nuclear materials from uses permitted by law or treaty.

Disposal and Storage (52.200)

Studies, including economic, related to methods for the management, disposal, or storage of radioactive wastes, e.g., land burial, sea disposal, tank storage, or salt mine storage. Geological, hydrological, and seismological studies related to waste disposal are included. Monitoring, transport, and distribution of radioactive materials in the atmosphere, soil, and waters of the Earth are included under ENVIRONMENTAL AND EARTH SCIENCES.

Handling Equipment and Procedures (52.300)

Design, construction, and operation of equipment and facilities for handling radioactive materials, e.g., remote-handling equipment, glove boxes, and hot cells. Non-reactor criticality studies are included.

Transportation (52.400)

Regulatory and administrative aspects of radioactive materials shipping. Design, development, evaluation, and testing of radioactive materials shipping containers.

Radioactive waste processing is included under CHEMISTRY.

PARTICLE ACCELERATORS (54.000)

Particle, ion, atom, or molecule accelerators. The arrangement is as follows:

Design, Development, and Operation (54.100)

Auxiliaries and Components (54.200)

Ion Sources and Injection and Extraction Systems (54.300)

Ion Optics and Field Calculations (54.400)

Storage Rings (54.500)

Experimental Facilities (Includes Radiation Targets) (54.600)

PHYSICS (ASTROPHYSICS AND COSMOLOGY) (56.000)

Cosmic Radiation (56.100)

Cosmic radiation, including exposure ages and induced radioactivity of extraterrestrial material, e.g., meteorites and lunar material. Cosmic-ray interactions with the atmosphere and with the geomagnetic field are included under PHYSICS (ATMOSPHERIC).

Stars (56.200)

Composition, evolution, physical conditions, and nucleogenesis of stars; including neutron stars, black holes, and other starlike objects. Celestial mechanics and routine astronomical observations, e.g., sky surveys, are excluded.

Quasi-Stellar, Radio, and X-Ray Sources (56.300)

Theory, detailed studies, and location of such objects.

Solar Phenomena (56.400)

Sunspots and solar prominences, disturbances, wind, flares, radio bursts, magnetic fields, structure, and spectra. Solar wind interactions with the atmosphere or geomagnetic field are included under PHYSICS (ATMOSPHERIC).

Galaxies (56.500)

Formation, structure, and evolution of galaxies, characteristics of interstellar medium, and identification of molecular species in space.

Cosmology (56.600)

Structure and evolution of the Universe, gravitational collapse and detection of gravitational waves, and tests of general relativity. Gravitational wave detectors are included under INSTRUMENTATION. General relativity theory and field theories of gravitation are included under PHYSICS (HIGH-ENERGY).

Planetary Phenomena (56.700)

Interplanetary magnetic fields, radio emissions from planets, natural radioactivity of extraterrestrial materials,

formation and evolution of planetary systems (including the solar system), and radiation belts. Van Allen belts are included under PHYSICS (ATMOSPHERIC).

PHYSICS (ATMOSPHERIC) (58.000)

Auroral and Ionospheric Phenomena (58.100)

Associated particle kinetics only.

Effects of Nuclear Detonations (58.200)

Atmospheric effects only.

Magnetospheric Phenomena (58.300)

PHYSICS (ATOMIC AND MOLECULAR) (60.000)

Beams and Their Reactions (60.100)

Methods of production and techniques of using atomic, electron, ion, and molecular beams.

Electron and ion sources not developed for specific applications.

Reactions of beams with materials in bulk (e.g., scattering by surfaces, secondary emission, sputtering yields, etc.)

Atomic and Molecular Properties (60.200)

Atomic properties (experimental and theoretical studies) of helium, hydrogen (also deuterium and tritium), the lanthanides, scandium, technetium, yttrium, and elements having $Z > 84$.

Molecular properties of deuterium, helium (He_2, He_3, etc.), helium hydrides, hydrogen (H_2, H_2^+, H_3^+, etc.), tritium, and compounds of technetium and of elements having $Z > 84$.

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules (60.300)

Properties of positronium, muonium, and muonic and mesic (π, K, etc.) atoms and molecules. Exotic atoms (involving antiprotons, hyperons, etc.) are included under PHYSICS (HIGH-ENERGY).

Basic mechanisms of positron annihilation, but not studies using positron annihilation as a tool.

Collision Phenomena (60.400)

Experimental and theoretical studies of elastic scattering, charge exchange (electron capture, electron loss, and electron attachment or detachment), excitation (deexcitation, excitation transfer), ionization, or dissociation in collisions of the following type: electron–ion, electron–atom, electron–molecule, ion–ion, ion–atom, ion–molecule, atom–atom, and atom–molecule.

Rearrangement collisions ($A + BC \rightarrow AB + C$), chemical exchange, and collisions in confined gases when no external beam is involved are excluded.

Atomic Theory (60.500)

Theory of atomic structure and properties when generally applicable. For theoretical studies of specific elements, see first statement under Atomic and Molecular Properties.

PHYSICS (ELECTROFLUID AND MAGNETOFLUID) (62.000)

Electrofluid and magnetofluid mechanics only.

PHYSICS (HIGH-ENERGY) (64.000)

Particle Interactions and Properties (Experimental) (64.100)

Experimental studies on the electromagnetic, weak, and strong interactions; on properties of particles and radiation quanta; on hypernuclei and hyperonic or antiprotonic atoms; and on particle or radiation quanta reactions with nuclei above the pion production threshold (~400 MeV). Information on the energy range below 400 MeV is included under PHYSICS (NUCLEAR).

Particle Interactions and Properties (Theoretical) (64.200)

Theoretical studies on the electromagnetic, weak, and strong interactions; on properties of particles and radiation quanta; on hypernuclei and hyperonic or antiprotonic atoms; and on particle or radiation quanta reactions with nuclei above the pion production threshold (~400 MeV). Information on the energy range below 400 MeV is included under PHYSICS (NUCLEAR).

Particle Invariance Principles and Symmetries (64.300)

Space-time symmetries and internal symmetries of particles and the applications of these symmetries to the electromagnetic, weak, and strong interactions.

Scattering Theory (64.500)

General scattering theory only; the application of scattering theory to specific interactions or types of particles is included under sections according to type of interaction.

NOTE: Category 64.400 (Field Theories) is discontinued. This subject area is now included in 76.000 PHYSICS (THEORETICAL).

PHYSICS (LOW-TEMPERATURE) (66.000)

Superfluidity (66.100)

Theory of superfluidity and studies on liquid helium as a superfluid.

Superconductivity (66.200)

Theory of superconductivity and superconducting phenomena.

Properties of specific superconducting materials are included under MATERIALS. Cryogenic equipment and superconducting magnets and devices are included under

ENGINEERING, except where categorization by application, e.g., PARTICLE ACCELERATORS, is more appropriate.

PHYSICS (NUCLEAR) (68.000)

The arrangement is as follows:

Neutron Interactions with Matter (68.100)

Neutron absorption, scattering, thermalization, transport, etc., in macroscopic systems, including solution of the neutron transport equation and theoretical neutron transport in matter in general geometric configurations.

Nuclear Properties and Reactions $A \leq 5$ (68.200)

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

Nuclear Properties and Reactions $6 \leq A \leq 19$ (68.300)

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

Nuclear Properties and Reactions $20 \leq A \leq 38$ (68.400)

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

Nuclear Properties and Reactions $39 \leq A \leq 58$ (68.500)

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

Nuclear Properties and Reactions $59 \leq A \leq 89$ (68.600)

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

Nuclear Properties and Reactions $90 \leq A \leq 149$ (68.700)

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

Nuclear Properties and Reactions $150 \leq A \leq 189$ (68.800)

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

Nuclear Properties and Reactions $190 \leq A \leq 219$ (68.900)

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

Nuclear Properties and Reactions $A \geq 220$ (69.100)

Mass, charge distribution, binding energy, radioactive decay, energy levels and transitions, moments and spin, and nuclear reactions and scattering of specific nuclei, spontaneous and induced fission.

Nuclear Theory (69.200)

Nuclear structure, nuclear matter, nuclear reactions and scattering, nuclear moments and spin, radioactive decay, spontaneous and induced fission, and nuclear models.

PHYSICS (PLASMA AND THERMONUCLEAR) (70.000)

This category has been renamed CONTROLLED THERMONUCLEAR RESEARCH. The Recon Number 70.000 was not changed.

PHYSICS (RADIATION AND SHIELDING) (72.000)

Radiation Physics (72.100)

Basic physical characteristics of radiation or of radiation passage through or scattering from materials not generally defined as shielding. This includes experimental or theoretical studies of range-energy relations, energy loss mechanisms, and absorption mechanisms, and calculations of dose distribution in tissue equivalent materials or phantoms. Dose determinations in biological materials is included under LIFE SCIENCES. Neutron transport in macroscopic systems is included under PHYSICS (NUCLEAR).

Radiation Protection Standards (72.200)

Standards written for a specific circumstance are included under appropriate sections.

Radiation Source Calibration and Standardization (72.300)

Radiation source design and fabrication or radiation source preparation are included under ISOTOPE AND RADIATION SOURCE TECHNOLOGY or CHEMISTRY.

Shielding Calculations and Experiments (72.400)

Neutron shielding and shield fabrication are included under PHYSICS (NUCLEAR) and MATERIALS. Shield design is

included under sections for the application, e.g., PARTICLE ACCELERATORS or REACTOR TECHNOLOGY.

PHYSICS (THEORETICAL) (76.000)

General (76.100)

Theoretical physics applicable to nuclear science (e.g., general quantum theory and mathematical physics) but not specifically applied. Theoretical physics when applied is arranged according to application.

Quantum Field Theories (76.200)

Basic studies of quantum field theories and quantum electrodynamics.

Gravitation and General Relativity (76.300)

Basic studies of gravitation theory and general relativity theory. Gravitational collapse, gravitational wave detection, and tests of general relativity are included under PHYSICS (ASTROPHYSICS AND COSMOLOGY).

REACTOR TECHNOLOGY AND REGULATION (77.000)

Design, development, construction, and operation of nuclear fission reactors.

Includes: fuel elements; cooling systems; pressure vessels; shielding: loading machines; steam and power conversion systems; components; auxiliary systems; accessories.

Excludes: control systems (use 79.400); economics (use 79.500); fuel cycle economics (use 79.600); fuels, general aspects (use 79.300); safety and siting (use 77.900); nuclear insurance (use 77.910).

Power Reactors, Non-Breeding, Light-Water Moderated, Boiling Water Cooled (77.100)

Includes: BWR-type.

Power Reactors, Non-Breeding, Light-Water Moderated, Non-Boiling Water Cooled (77.200)

Includes: PWR-type.

Power Reactors, Non-Breeding, Graphite Moderated (77.300)

Includes: GCR, AGR, HTGR, Molten Salt types.

Power Reactors, Non-Breeding, Otherwise Moderated or Unmoderated (77.400)

Includes: Heavy Water type.

Power Reactors, Breeding (77.500)

Includes: LMFBR, MSBR, GCFR.

Research, Test, Experimental, Zero-Power, and Training Reactors and Subcritical Assemblies (77.600)

Plutonium Production, Isotope Production, Chemonuclear, Materials Testing, and Material Processing Reactors (77.700)

Space, Mobile, Propulsion, Transportable, and Package Reactors (77.800)

Nuclear Ships Licensing and Regulation (77.810)

Safe-navigation regulations.

Reactor Safety and Environmental Aspects (77.900)

Reactor accident analysis, safety system performance (e.g., ECCS), environmental consequences of reactor construction and operation, including nonradioactive aspects, in-reactor facility waste processing and radiation protection.

Reactor Accident Liability (77.910)

Legal aspects of nuclear damage and risk, insurance, and financial security.

Reactor Theory and Calculation (79.100)

Reactor physics calculations and in-pile measurements (in reactors of any type).

Includes: criticality; dynamics; kinetics; lattice cell parameters; neutronics; physics; thermohydraulics.

Reactor Components and Accessories (79.200)

Design, construction, assembly, and performance—where no reactor type is specified.

Includes: buildings; coolants; cooling systems; loading machines; pressure vessels; shielding; structures.

Reactor Fuels (79.300)

Design, assembly, and performance of fuel elements and assemblies, fuel cycles, fuel handling procedures, and fuel requirements—where no reactor type is specified.

Excludes: production and fabrication of fuel element component materials; burnup in specific reactors types (use 77.100–77.800); fuel cycle economics (use 79.600); loading machines (use 79.200).

Reactor Control Systems (79.400)

Systems for the control and surveillance of reactors of any type.

Includes: control elements and incorporated instruments; control element drive units; control by computers; data processing and display systems; systems for alarm and automatic shutdown; automatic initiation of protective systems or actions.

Excludes: instruments of potential use in control systems; safety and protective systems (e.g., ECCS).

Nuclear Power Plant Economics (79.500)

General studies of power plant construction and operation. Excludes: fuel cycle economics (use 79.600).

Reactor Fuel Cycle Economics (79.600)

Fuel resources and requirements and overall fuel cycle costs.

Reactor Licensing and Regulation (79.700)

All reactor Docket material (must have secondary category to type, e.g., 77.100, 77.200, and any other appropriate category), general licensing procedures and regulations.

GENERAL (80.000)

Civilian Defense (80.100)

Administrative and planning aspects only.

Energy Utilization and Economics (80.200)

Economic and feasibility studies of nonnuclear energy source development and utilization.

Note: only AEC-sponsored reports that are not announced in the journal *Energy Abstracts for Policy Analysis (EAPA)* are included.

Information Handling (80.300)

Manual or computer-based systems for data or information acquisition, processing, transmission and retrieval.

Law (80.400)

Legislative action and activities of agencies, committees, or organizations.

Management (80.500)

Organization, administration, financing, and general description of nuclear institutes and programs, e.g., directories, reference books, manuals, lists of publications, general bibliographies, training programs, etc.

Mathematics and Computers (80.600)

Mathematical methods and models and computer codes and programs for solving problems not related to nuclear science.

Miscellaneous (80.700)

Publicly available administrative and research and development reports from the United States Atomic Energy Commission and the national nuclear energy organizations of the United Kingdom, Canada, Sweden, Denmark, Japan, Australia, France, West Germany, and Norway which are outside the subject scope of other categories.

Chemistry (80.710)

Life Sciences (80.720)

Materials (80.730)

Physics and Engineering (80.740)

Part 2

EXTENT OF INTEREST IN THE ELEMENTS

ACTINIUM

All scientific and technical aspects

ALUMINUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

AMERICIUM

All scientific and technical aspects

ANTIMONY

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

ARGON

Applications of the element in nuclear technology or the behavior of the element in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

ARSENIC

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

ASTATINE

All scientific and technical aspects

BARIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

BERKELIUM

All scientific and technical aspects

BERYLLIUM

Analysis, determination, and separation

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy

Nuclear properties and nuclear reactions

Radiation effects

Radiochemistry

Solid-state properties

BISMUTH

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Isotopes (excluding routine applications as tracers or radiation sources)

Metabolism, tissue distribution, and toxicology of radioisotopes

Metallurgy of liquid bismuth

Nuclear properties and nuclear reactions

Radiation effects
Radiochemistry

BORON

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

BROMINE

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

CADMIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

CALCIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

CALIFORNIUM

All scientific and technical aspects

CARBON

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Properties and fabrication of nuclear-grade graphite and graphite fuel materials
Radiation effects
Radiochemistry

CERIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

CESIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

CHLORINE

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

CHROMIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

COBALT

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

COPPER

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

CURIUM

All scientific and technical aspects

DYSPROSIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application) compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

EINSTEINIUM

All scientific and technical aspects

ERBIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

EUROPIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

FERMIUM

All scientific and technical aspects

FLUORINE

Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

FRANCIUM

All scientific and technical aspects

GADOLINIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

GALLIUM

Applications of the element and its alloys, compounds, and systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

GERMANIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

GOLD

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

HAFNIUM

Applications of the element and its alloys, compounds, and systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

HELIUM

Applications of the element in nuclear technology or the behavior of the element in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Superfluidity

HOLMIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

HYDROGEN

Applications of the element or its compounds and systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment
Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of deuterium and tritium
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

INDIUM

Applications of the element and its alloys, compounds, and systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
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IODINE

Analysis, determination, and separation
Applications of the element or its compounds or systems in nuclear technology or the behavior of the element, its compounds, or its systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

IRIDIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry

IRON

Applications of the element and its alloys or systems, including steel and stainless steel, in nuclear technology or the behavior of the element, its alloys, or its systems in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
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Radiochemistry

KRYPTON

Analysis, determination, and separation
Applications of the element in nuclear technology or the behavior of the element in an actual or a simulated reactor environment
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
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Radiochemistry

LANTHANUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
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Isotopes (excluding routine applications as tracers or radiation sources)
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LAWRENCIUM (103)

All scientific and technical information

LEAD

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
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LITHIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
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Metabolism, tissue distribution, and toxicology of radioisotopes
Nuclear properties and nuclear reactions
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Radiochemistry

LUTETIUM

Analysis, determination, and separation
Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

Atomic properties
Isotopes (excluding routine applications as tracers or radiation sources)
Metabolism, tissue distribution, and toxicology of radioisotopes
Metallurgy of the element or its alloys (steels containing this element are excluded unless the study concerns an actual or simulated nuclear application), compounds, or systems, excluding mineralogy
Nuclear properties and nuclear reactions
Radiation effects
Radiochemistry
Solid-state properties

MAGNESIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
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MANGANESE

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment
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MENDELEVIUM

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MERCURY

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MOLYBDENUM

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NEPTUNIUM

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NOBELIUM

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OSMIUM

Applications of the element or its alloys, compounds, or systems in nuclear technology or the behavior of the element, its alloys, compounds, or systems in an actual or a simulated reactor environment

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OXYGEN

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PLUTONIUM

All scientific and technical aspects

POLONIUM

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POTASSIUM

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PROMETHIUM

All scientific and technical aspects

PROTACTINIUM

All scientific and technical aspects

RADIUM

All scientific and technical aspects

RADON

All scientific and technical aspects

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TECHNETIUM

All scientific and technical aspects

TELLURIUM

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THALLIUM

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THORIUM

All scientific and technical aspects except mining and routine industrial uses, e.g., thoriated cathodes

THULIUM

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TIN

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TRANSLAWRENCIUM ELEMENTS

All scientific and technical aspects

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URANIUM

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XENON

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YTTERBIUM

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YTTRIUM

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ZINC

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ZIRCONIUM

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Heat Transfer, 42.30, 77.00
Heated Effluents, 44.60
Heavy Water, Management, 52.00
Heavy Water, Production, 47.10
Heavy Water Reactors, 77.400
Helium Hydrides, 60.20
Helium, Superfluid, 66.00
High-Energy Physics, 64.00
High-Energy Physics Instrumentation, 46.10
Hot-Atom Chemistry, 40.41
Hot Cells, 42.60
HTGR-type Reactors, 77.300
Human Cells, 48.200, 48.50
Human Tissues, 48.50
Hydrides, 50.10
Hydrology, 44.00
Hypernuclei, 64.00
Hyperonic Atoms, 64.00
Information Handling, 80.30
Inorganic Chemistry, 40.20
Instrument Components, 46.30
Instrumentation, 46.00
Instrumentation Systems, 46.40
Instruments, 46.30, 46.40
Invariance Principles, 64.30
Invertebrates, 48.50
Ion Beams, 60.10
Ion Extraction, 54.30
Ion Injection, 54.30
Ion Optics, 54.40
Ion Sources, 60.10
Ion Sources, Accelerator, 54.30
Ionization, 60.40
Ionospheric Phenomena, 58.10
Irradiation Procedures, 48.10, 48.20, 48.40, 48.50
Isotope Dilution Analysis, 40.10
Isotope Effects, 40.22
Isotope Exchange, 40.23
Isotope Production, 40.23, 40.44, 47.100
Isotope Production Reactors, 77.70
Isotope Separation, Chemical, 40.23
Isotope Separation, Industrial, 47.10
Isotope Technology, 47.00
Labeled Compounds, 40.40, 40.42
Lasers, 42.20, 47.10, 70.60
Law, 80.40
Life Sciences, 48.00
Liquid Metals, 42.30
LMFBR-type Reactors, 77.500
Low-Temperature Physics, 66.00
Magnetic Fields, Interplanetary, 56.70
Magnetic Fields, Solar, 56.40
Magnetic Properties, 50.00
Magnetofluid Mechanics, 62.00
Man, 48.50
Management, 80.50
Manuals, 80.50
Masks, 42.60
Materials, 50.00
Materials Testing, 42.40
Materials Testing or Processing Reactors, 77.70
Mathematical Physics, 76.20
Mathematics, 80.60
Matter, 68.10
Medical Supplies, 47.30, 48.300
Mesic Atoms, 60.30
Metals, 42.30, 50.20
Meteorites, 56.10
Microorganisms, 48.30
Minerals, 44.10
Mining, 44.10
Miscellaneous Reports, 80.70
Moessbauer Effect, 40.00, 50.00
Moessbauer Spectrometers, 46.10
Molecular Beams, 60.10
Molecular Physics, 60.00
Molecular Properties, 60.20
Molten Salt Reactors, 77.300, 77.400
MSBR-type Reactors, 77.400
Muonic Atoms, 60.30
Muonium, 60.30
Natural Radioactivity, 44.30, 44.500
Neutron Interactions, 68.10
Neutron Sources, 47.30
Nitrides, 50.10
Nonnuclear Energy Source Development, 80.20
Nuclear Chemistry, 40.40
Nuclear Explosions, Atmosphere Effects, 58.20
Nuclear Explosions, Civil Uses, 42.50
Nuclear Explosions, Site Surveys, 44.50
Nuclear Institutes and Programs, 80.50
Nuclear Magnetic Resonance, 50.00
Nuclear Materials Management, 52.00
Nuclear Matter, 69.20
Nuclear Models, 69.20
Nuclear Phenomena, Galactic, 56.50
Nuclear Physics, 68.00

Nuclear Power Plant Economics, 79.50
Nuclear Power Plants, 44.50, 77.00
Nuclear Properties, 68.00
Nuclear Reaction Analysis, 40.11
Nuclear Reactions, 40.10, 40.40, 64.10, 68.00, 69.10, 69.20
Nuclear Reactors, 77.00
Nuclear Spectroscopic Instruments, 46.10
Nuclear Structure, 69.20
Nuclear Theory, 69.20
Nucleate Boiling, 42.30
Nuclei, 64.00, 68.00, 69.10, 69.20
Nucleogenesis, 56.20
Nuclide Kinetics, 48.70
Nuclide Toxicology, 48.70
Oceanography, 44.00
Ores, Chemical Processing, 40.24
Ores, Geology, 44.10
Organic Chemistry, 40.20
Organisms, 48.00
Oxides, 50.10
Particle Accelerators, 54.00
Particle Interactions, 64.00
Particle Invariance, 64.30
Particle Kinetics, 58.10
Particle Symmetry, 64.30
Particle Trapping, 58.30
Pest Control, 47.30, 48.300
Phase Studies, 40.20, 40.40, 50.00
Physical Chemistry, 40.20
Physical Properties, 40.20, 40.40, 50.00
Physicochemical Properties, 40.21, 40.42
Physics, 72.00
Planetary Phenomena, 56.70
Plankton, 48.30
Plant Cells, 48.40
Plants, 48.40
Plasma Physics, 70.00
Plasma Physics, Galactic, 56.50
Plastics, 50.30
Plowshare Project, 42.50
Plutonium Production Reactors, 77.700
Polymer Production, 47.30
Positron Annihilation, 60.30
Positronium, 60.30
Power Plants, 44.60, 44.700, 77.00
Power Reactors, 77.00
Power Sources, 47.20, 80.200
Pressure Vessels, 77.00
Propulsion, 47.20, 77.80
Prospecting, 44.10, 44.400
Protective Equipment, 42.60
Protective Structures, 42.60
Publication Lists, 80.50
PWR-type Reactors, 77.20
Quantum Electrodynamics, 76.20
Quantum Field Theory, 76.20
Quantum Theory, 76.10
Quasi-Stellar Sources, 56.30
Radiation Belts, 56.70, 58.00
Radiation, Biological Effects, 48.00
Radiation Chemistry, 40.30
Radiation Detection Instruments, 46.10
Radiation Detectors, 46.10, 46.20
Radiation Doses, 46.20, 48.50, 48.60
Radiation Dosimetry, 46.20, 48.60
Radiation Effects, Biological, 48.00, 48.10, 48.20, 48.30, 48.40, 48.50, 48.60
Radiation Effects, Chemical, 40.30
Radiation Effects, Commodity Processing, 47.30
Radiation Effects, Instrument Systems, 46.30
Radiation Effects, Metallurgical, 50.00
Radiation Effects, Physical, 50.00
Radiation Effects, Solid-State, 50.00
Radiation Environments, 42.60
Radiation, Galactic, 56.50
Radiation Hazards, 44.30, 48.000
Radiation Interactions, 64.00
Radiation Monitoring, 44.30
Radiation Monitors, 46.10
Radiation Physics, 72.00
Radiation Protection Standards, 72.20
Radiation Quanta, 64.00
Radiation Scattering, 72.10
Radiation Source Calibration, 72.30
Radiation Source Standardization, 72.30
Radiation Source Technology, 47.00
Radiation Sources, Biological, External, 48.10, 48.500
Radiation Sources, Biological, Internal, 48.500, 48.60
Radiation Sources, Design, 47.30
Radiation Sources, Use in Earth Sciences, 44.40
Radiation Sources, Use in Instruments, 46.20
Radiation Surveys, 44.50
Radiation Targets, 54.60
Radiation Therapy, 48.51
Radiation Transport, 72.10
Radio Bursts, 56.40
Radio Emission, 56.70
Radio Sources, 56.30
Radioactive Decay, 40.41, 68.00, 69.10, 69.20
Radioactive Effluents, 44.20
Radioactive Materials, Biological Incorporation, 44.300, 48.60
Radioactive Materials, Chemical Properties, 40.42
Radioactive Materials, Discharge to Environment, 44.20
Radioactive Materials, Management, 52.00
Radioactive Materials, Monitoring in Environment, 44.30
Radioactive Waste, Chemical Processing, 40.43
Radioactive Waste, Disposal, 44.20, 52.00
Radioactive Waste Management, 52.00
Radioactivity Monitoring, 44.30
Radioactivity Transport, 44.30
Radiochemical Analysis, 40.13
Radiochemical Processing Plants, 40.40, 44.20, 44.50, 44.60
Radiochemistry, 40.40
Radioisotope Production, 40.44, 77.700
Radioisotopes, Analytical Use, 40.13
Radioisotopes, Distribution in Environment, 44.20, 44.30, 48.60, 48.70
Radioisotopes, Use in Biology, 48.80
Radioisotopes, Use in Earth Sciences, 44.40
Radioisotopes, Use in Industry, 47.30
Radioisotopes, Use in Power Sources, 47.20
Radiolysis, 40.30
Radiometric Analysis, 40.13
Radiometric Instruments, 46.20
Radiometric Techniques, 40.130, 44.40
Radiomimetic Effects, 48.00
Radionuclide Effects, 48.60, 48.70
Radioprotective Substances, 48.00
Radiopreservation, 47.30, 48.30
Radiosterilization, 47.30, 48.300
Radiotherapy, 48.50
Reactor Accident Liability, 77.91
Reactor Control Systems, 79.40
Reactor Engineering, 77.00

Reactor Fuel Cycle Economics, 79.60
Reactor Fuel Fabrication Plants, 44.20, 44.50, 50.00
Reactor Fuel Loading Machines, 79.20
Reactor Fuel Processing Plants, 40.45, 44.20, 44.50, 44.60
Reactor Fuels, Analysis, 40.10
Reactor Fuels, Burnup, 40.10, 77.00
Reactor Fuels, Design, 77.00
Reactor Fuels, Materials Properties, 50.00
Reactor Fuels, Reprocessing, 40.45
Reactor Licensing and Regulation, 79.70
Reactor Physics, 79.10
Reactor Technology, 77.00
Reactor Theory and Calculation, 79.10
Recoils, 40.41
Reference Books, 80.50
Refractory Materials, 50.30
Relativistic Mechanics, 76.30
Relativity Theory, 76.30
Remote-Handling Equipment, 52.30
Rod Bundles, 42.30
Safeguards, 52.10
Safety Engineering, 42.70
Scattering Theory, 64.50
Secondary Emission, 60.10
Seismology, 44.50
Shielding, 72.00, 77.00
Shielding Calculations, 72.40
Shielding Theory, 72.40
Shipping Containers, 52.40
Site Surveys, 44.50
Soil, 44.20, 44.30, 44.60, 44.700
Soil Moisture, 44.40
Solar Flares, 56.40
Solar Phenomena, 56.40
Solar System, 56.40
Solar Wind, 56.40
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Solid-State Properties, 50.00
Special Materials, 52.00
Spontaneous Fission, 68.00, 69.10, 69.20
Sputtering Yields, 60.10
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Sunspots, 56.40
Superconducting Equipment, 42.22
Superconductivity, 66.20
Superconductors, 42.22
Superfluid Helium, 66.10
Superfluidity, 66.10
Surface Phenomena, 50.000
Synthetic Fuels, 80.200
Testing, 42.40
Theoretical Physics, 76.00
Thermal Effluents, 44.60
Thermal Energy, 47.20
Thermionic Converters, 42.10
Thermoelectric Generators, 42.10
Thermonuclear Equipment, 70.80
Thermonuclear Physics
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Training Programs, 80.50
Transportation, 52.40
Tritium, 40.10, 40.22, 40.23, 40.40, 47.10, 48.70, 52.00, 60.20
Two-Phase Flow, 42.30
Ultraviolet Radiation, 48.00
Universe, 56.60
Uranium Enrichment, 47.10
Vacuum Engineering, 42.80
Van Allen Belts, 58.00
Vertebrates, 48.50
Waste Disposal, 44.20, 44.600, 44.700, 52.00
Waste Management, 52.00
Waste Processing, 40.43
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Well Logging, 44.40
X-Ray Analysis, 40.12, 40.13
X-Ray Sources, 56.30
Yeasts, 48.30

Appendix II

JOURNAL LIST

Journals from which articles have been abstracted and indexed in *NSA*, Vols. 29 and 30, are listed here alphabetically by title abbreviation.

The foreign language journals in this list available in English language translation are indicated and the title of the English language journal is included.

The title abbreviations are based on the National Clearinghouse for Periodical Title Word Abbreviations, *Word Abbreviation List* published by the Standards Committee Z-39 of the American National Standards Institute.

TID-4579-R8 *Serial Titles Cited in Nuclear Science Abstracts* lists the titles and abbreviations of the journals regularly scanned for *NSA* as well as those from which an occasional item is taken. This publication is available from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161, in full size or microfiche copy.

A

Acad. Roy. Belg., Cl. Sci., Mem., Collect. 8
Academie Royale de Belgique, Classe des Sciences, Memoires, Collection in 8 (Formerly carried as Memoires, Academie Royale des Belgique, Classe des Sciences, Collection in 8 (Belgium)

Accidents (London)
Accidents (London) (England)

Accounts Chem. Res.
Accounts of Chemical Research (U.S.)

ACEC (Ateliers Constr. Elec. Charleroi) Rev.
ACEC (Ateliers de Constructions Electriques de Charleroi) Reviews (Belgium)

Acta Agrobot.
Acta Agrobotanica (Poland)

Acta Aliment.
Acta Alimentaria Academiae Scientiarum Hungaricae (Hungary)

Acta Anat.
Acta Anatomica (Switzerland)

Acta Astron.
Acta Astronomica, Polska Akademia Nauk (Formed by Merger of Acta Astronomica, Ser. A, Ser. B, and Ser. C) (Poland)

Acta Biochim. Biophys. (Budapest)
Acta Biochimica et Biophysica, Academiae Scientiarum Hungaricae (Budapest) (Hungary)

Acta Biochim. Pol.
Acta Biochimica Polonica (Poland)

Acta Biol. Acad. Sci. Hung.
Acta Biologica Academiae Scientiarum Hungaricae (Hungary)

Acta Biol. Cracov., Ser. Zool.
Acta Biologica Cracoviensia, Serie Zoologie (Poland)

Acta Biol. Med. Ger.
Acta Biologica et Medica Germanica (East Germany)

Acta Chem. Fenn.
Acta Chemica Fennica (Finland)

Acta Chem. Scand.
Acta Chemica Scandinavica (Denmark)

Acta Chim. Acad. Sci. Hung.
Acta Chimica Academiae Scientiarum Hungaricae (Hungary)

Acta Chir. Scand.
Acta Chirurgica Scandinavica (Sweden)

Acta Crystallogr., Sect. A
Acta Crystallographica, Section A. Crystal Physics, Diffraction, Theoretical and General Crystallography (Continues in Part Acta Crystallographica) (Denmark)

Acta Crystallogr., Sect. B
Acta Crystallographica, Section B. Structural Crystallography and Crystal Chemistry (Continues in Part Acta Crystallographica) (Denmark)

Acta Endocrinol.
Acta Endocrinologica (Denmark)

Acta Endocrinol., Suppl.
Acta Endocrinologica, Supplementum (Denmark)

Acta Fac. Rerum Natur. Univ. Comenianae, Phys.
Acta Facultatis Rerum Naturalium Universitatis Comenianae, Physica (Czechoslovakia)

Acta Geophys. Pol.
Acta Geophysica Polonica (Poland)

Acta Haematol.
Acta Haematologica. International Journal of Hematology (Switzerland)

Acta Haematol. Pol.
Acta Haematologica Polonica (Poland)

Acta Hydrobiol.
Acta Hydrobiologica, Polske Akademia Nauk, Zaklad Biologii Wod (Poland)

Acta Mech.
Acta Mechanica (Austria - U.S.)

Acta Med. Biol. (Niigata)
Acta Medica et Biologica (Niigata) (Japan)

Acta Med. Okayama
Acta Medicinae Okayama (Japan)

Acta Met.
Acta Metallurgica (U.S.)

Acta Microbiol. Pol., Ser. A
Acta Microbiologica Polonica, Series A. Microbiologia Generalis (Poland)

Acta Microbiol. Pol., Ser. B
Acta Microbiologica Polonica, Series B. Microbiologia Applicata (Poland)

Acta Neurol. Belg.
Acta Neurologica Belgica (Belgium)
Continues in part Acta Neurol. Psychiat. Belg.

Acta Neuropathol.
Acta Neuropathologica (Germany)

Acta Odontol. Scand.
Acta Odontologica Scandinavica (Sweden)

Acta Pathol. Microbiol. Scand., Sect. A
Acta Pathologica et Microbiologica Scandinavica, Section A. Pathology (Denmark)

Acta Pathol. Microbiol. Scand., Sect. A, Suppl.
Acta Pathologica et Microbiologica Scandinavica, Section A. Pathology, Supplementum (Formerly Acta Pathologica et Microbiologica Scandinavica, Supplementum) (Denmark)

Acta Pathol. Microbiol. Scand., Sect. B
Acta Pathologica et Microbiologica Scandinavica, Section B. Microbiology and Immunology (Denmark)

Acta Pharm. Toxicol.
Acta Pharmacologica et Toxicologica (Denmark)

Acta Phys. Acad. Sci. Hung.
Acta Physica Academiae Scientiarum Hungaricae (Hungary)

Acta Phys. Austr.
Acta Physica Austriaca (Austria)

Acta Phys. Austr., Suppl.
Acta Physica Austriaca, Supplementum (Austria)

Acta Physiol. Latinoamer.
Acta Physiologica Latinoamericana (Argentina)

Acta Physiol. Pol.
Acta Physiologica Polonica (Poland)

Acta Phys. Pol.
Acta Physica Polonica (Poland)
Divided into Series A and B, Beginning January 1970

Acta Phys. Pol., A
Acta Physica Polonica, A (Poland)

Acta Phys. Pol., B
Acta Physica Polonica, B (Poland)

Acta Phys. Slovaca
Acta Physica Slovaca (Czechoslovakia)
Supersedes Fyz. Cas.

Acta Pol. Pharm.
Acta Poloniae Pharmaceutica (Poland)

Acta Polytech. Scand., Civil Eng. Ser.
Acta Polytechnica Scandinavica, Civil Engineering Series (Formerly Acta Polytechnica Scandinavica, Civil Engineering and Building Constructin Series) (Finland)

Acta Polytech. Scand., Phys. Nucl. Ser.
Acta Polytechnica Scandinavica, Physics Including Nucleonics Series (Finland)

Acta Radiol., Suppl.
Acta Radiologica, Supplementua (Sweden)

Acta Radiol., Ther., Phys., Biol.
Acta Radiologica, Therapy, Physics, Biology (Sweden)

Acta Soc. Bot. Pol.
Acta Societatis Botanicorum Poloniae (Poland)

Acta Tech. Acad. Sci. Hung.
Acta Technica Academiae Scientiarua Hungaricae (Hungary)

Acta Tech. CSAV
Acta Technica CSAV (Ceskoslovenska Akademia Ved) (Czechoslovakia)

Acta Tuberc. Pneumol. Belg.
Acta Tuberculosea et Pneumologica Belgica (Belgium)

Acta Univ. Wratislaviensis
Acta Universitatis wratislaviensis (Polsnd)

Acta Urol. Belg.
Acta Urologica Belgica (Belgium)

Adhaesion
Adhaesion (West Germany)

Advan. At. Mol. Phys.
Advances in Atomic and Molecular Physics (U.S.)

Advan. Cryog. Eng.
Advances in Cryogenic Engineering (U.S.)

Advan. Geophys.
Advances in Geophysics (U.S.)

Advan. Inorg. Chem. Radiochem.
Advances in Inorganic Chemistry and Radiochemistry (U.S.-England)

Advan. Intern. Med.
Advances in Internal Medicine (U.S.)

Advan. Nucl. Phys.
Advances in Nuclear Physics (U. S.)

Advan. Phys.
Advances in Physics (England)

Advan. Phys. Org. Chem.
Advances in Physical Organic Chemistry (U.S.)

Advan. Radiat. Chem.
Advances in Radiation Chemistry (U. S.)

Advan. Reprod. Physiol.
Advances in Reproductive Physiology (England)

Advan. X-Ray Anal.
Advances in X-Ray Analysis (U.S.)

Aerosp. Med.
Aerospace Medicine (Formerly The Journal of Aviation Medicine) (U. S.)

Aerotecnica
Aerotecnica, L. (Italy)
Merged with Missili Spazio to form Aerotec.-Missili Spazio

Agr. Biol. Chem. (Tokyo)
Agricultural and Biological Chemistry (Tokyo) (Japan)

Agriculture (Paris)
Agriculture (Paris) (France)

Agri Hort. Genet.
Agri Hortique Genetika (Sweden)

Agrochemophysica
Agrochemophysica (South Africa)

Agrochimica
Agrochimica (Italy)

AIAA (Amer. Inst. Aeronaut. Astronaut.) J.
AIAA (American Institute of Aeronautics and Astronautics) Journal (Combining the ARS Journal and the Journal of Aerospace Science) (U.S.)

A.I.Ch.E. (Amer. Inst. Chem. Eng.) J.
A.I.Ch.E. (American Institute of Chemical Engineers) Journal (U.S.)

AIP (Amer. Inst. Phys.) Conf. Proc.
AIP (American Institute of Physics) Conference Proceedings (U.S.)

Akush. Ginekol.
Akusherstvo i Ginekologiya (U.S.S.R.)

Aliment. Vie
Alimentation et la Vie (Formerly Bulletin de la Societe Scientifique d'Hygiene Alimentaire et d'Alimentation Rationnelle) (France)

Allg. Prakt. Chem.
Allgemeine und Praktische Chemie (Austria)

Alta Freq.
Alta Frequenza. Rivista di Radiotecnica, Telefonia e Acustica Applicata (Italy)

Ambio
Ambio (Norway)

Amer. Ceram. Soc. Bull.
American Ceramic Society Bulletin, The (U.S.)

Amer. Fam. Physician
American Family Physician (U.S.)
Supersedes American Family Physician - GP

Amer. Ind. Hyg. Ass. J.
American Industrial Hygiene Association Journal (U.S.)

Amer. J. Cardiol.
American Journal of Cardiology, The (U.S.)

Amer. J. Epidemiol.
American Journal of Epidemiology (U.S.)

Amer. J. Med.
American Journal of Medicine, The (U.S.)

Amer. J. Obstet. Gynecol.
American Journal of Obstetrics and Gynecology (U.S.)

Amer. J. Ophthalmol.
American Journal of Ophthalmology (U.S.)

Amer. J. Pathol.
American Journal of Pathology, The (U.S.)

Amer. J. Phys.
American Journal of Physics (U.S.)

Amer. J. Proctol.
American Journal of Proctology (U.S.)

Amer. J. Pub. Health
American Journal of Public Health (U.S.)

Amer. J. Roentgenol., Radium Ther. Nucl. Med.
American Journal of Reontgenology, Radium Therapy and Nuclear Medicine, The (U.S.)

Amer. J. Surg.
American Journal of Surgery, The (U.S.)

Amer. J. Trop. Med. Hyg.
American Journal of Tropical Medicine and Hygiene (U.S.)

Amer. J. Vet. Res.
American Journal of Veterinary Research (U.S.)

Amer. Soc. Test. Mater., Spec. Tech. Publ.
American Society for Testing and Materials, Special Technical Publication (U. S.)

Amts-Mitteilungsbl. Bundesanst. Materialpruef.
Amts- und Mitteilungsblatt der Bundesanstalt fuer Materialpruefung (West Germany)

An. Acad. Brasil. Cienc.
Anais da Academia Brasileira de Ciencias (Brazil)

Anaesthesist
Anaesthesist (West Germany)

Anal. Biochem.
Analytical Biochemistry (U.S.)

Anal. Chem.
Analytical Chemistry (U.S.)

Anal. Chim. Acta
Analytica Chimica Acta (Netherlands)

Anal. Lett.
Analytical Letters (U.S.)

Analusis
Analusis (France)
Ceased publication

Analyst
Analyst, The (England)

Anat. Rec.
Anatomical Record, The (U.S.)

An. Espan. Odontestomatol.
Anales Espanoles de Odontoestomatologia (Spain)

An. Fis.
Anales de Fisica. Real Sociedad Espanola de Fisica y Quimica (Formerly Anales de la Real Sociedad Espanola de Fisica y Quimica, Serie A. Fisica) (Spain)

Angew. Bot.
Angewandte Botanik (West Germany)

Angew. Chem.
Angewandte Chemie (West Germany)

Angew. Chem. Int. Ed. Engl.
Angewandte Chemie. International Edition in English (U.S.-West Germany)

An. Inst. Geofis. UNAM (Univ. Nac. Auton. Mex.)
Anales del Instituto de Geofisica UNAM (Universidad Nacional Autonoma de Mexico) (Mexico)

Ann. Acad. Med. Lodzensis
Annales Academiae Medicae Lodzensis (Poland)

Ann. Acad. Sci. Fenn., Ser. A VI
Annales Academiae Scientiarum Fennicae, Series A VI. Physica (Finland)

Ann. Amelior. Plant.
Annales de l'Amelioration des Plantes (Formerly Annales de l'Institut National de la Recherche Agronomique, Serie B) (France)

Ann. Appl. Biol.
Annals of Applied Biology (England)

Ann. Biol. Clin. (Paris)
Annales de Biologie Clinique (Paris) (France)

Ann. Biomed. Eng.
Annals of Biomedical Engineering (U. S.)

Ann. Chem.
Annalen der Chemie, Justus Liebigs (West Germany)

Ann. Chir. Plast.
Annales de Chirurgie Plastique (France)

Ann. Clin. Res.
Annals of Clinical Research (Supersedes Annales Medicinae Internae Fenniae and Annales Paediatriae Fenniae) (Finland)

Ann. Endocrinol. (Paris)
Annales d'Endocrinologie (Paris) (France)

Ann. Entomol. Soc. Amer.
Annals of the Entomological Society of America (U.S.)

Ann. Gastroenterol. Hepatol.
Annales de Gastroenterologie et d'Hepatologie (France)

Ann. Geofis. (Rome)
Annali di Geofisica (Rome) (Italy)

Ann. Geophys.
Annales de Geophysique (France)

Ann. Hum. Genet.
Annals of Human Genetics (England)

Ann. Immunol. (Paris)
Annales d'Immunologie (Paris) (France)
Continues in part Ann. Inst. Pasteur, Paris

Ann. Inst. Henri Poincare, Sect. A
Annales de l'Institut Henri Poincare, Section A. Physique Theorique (France)

Ann. Ist. Super. Sanita
Annali dell' Istituto Superiore di Sanita (Italy)

Ann. Med. Exp. Biol. Fenn. (Helsinki)
Annales Medicinae Experimentalis et Biologiae Fenniae (Helsinki) (Finland)

Ann. Med. Interne
Annales de Medecine Interne (France)
Supersedes Bull. Mem. Soc. Med. Hop. Paris

Ann. Med. Nav.
Annali di Medicina Navale (Italy)

Ann. Mines
Annales des Mines (France)

Ann. Nucl. Sci. Eng.
Annals of Nuclear Science and Engineering (England)
Supersedes J. Nucl. Energy

Ann. N.Y. Acad. Sci.
Annals of the New York Academy of Sciences (U.S.)

Ann. Occup. Hyg.
Annals of Occupational Hygiene, The (England)

Ann. Otol., Rhinol., Laryngol.
Annals of Otology, Rhinology, and Laryngology (U.S.)

Annot. Zool. Jap.
Annotationes Zoologicae Japonenses (Japan)

Ann. Pediat. (Paris)
Annales de Pediatrie (Paris) (France)

Ann. Pharm. (Poznan)
Annales Pharmaceutici (Poznan) (Poland)

Ann. Pharm. Fr.
Annales Pharmaceutiques Francaises (France)

Ann. Phys. (Leipzig)
Annalen der Physik (Leipzig) (East Germany)

Ann. Phys. (N.Y.)
Annals of Physics (New York) (U.S.)

Ann. Phys. Biol. Med.
Annales de Physique Biologique et Medicale (France)

Ann. Radiol. Diagn.
Annali di Radiologia Diagnostica (Bologna) (Italy)

Ann. Rheum. Dis.
Annals of the Rheumatic Diseases (England)

Ann. Soc. Sci. Brux. Ser. I
Annales de la Societe Scientifique de Bruxelles. Serie I (Belgium)

Ann. Technol. Agr.
Annales de Technologie Agricole (France)

Ann. Univ. Mariae Curie-Sklodowska, Lublin-Pol., Sect. AA
Annales Universitatis Mariae Curie-Sklodowska, Lublin-Polonia, Sectio AA (Poland)

Ann. Univ. Turk., Ser. AI
Annales Universitatis Turkuensis, Series AI, Astronomica-Chemica-Physica-Mathematica (continues in part Annales Universitatis Turkuensis, Series A) (Finland)

Annu. Rep. Biol. Works, Fac. Sci., Osaka Univ.
Annual Report of Biological Works, Faculty of Science, Osaka University (Formerly Annual Report of Scientific Works, Faculty of Science, Osaka University) (Japan)

Annu. Rep. Radiat. Center Osaka Prefect.
Annual Report of the Radiation Center of Osaka Prefecture (Japan)

Annu. Rep. Res. Reactor Inst., Kyoto Univ.
Annual Reports of the Research Reactor Institute, Kyoto University (Japan)

Annu. Rev. Mater. Sci.
Annual Review of Materials Science (U.S.)

Annu. Rev. Nucl. Sci.
Annual Review of Nuclear Science (U.S.)

Annu. Rev. Pharmacol.
Annual Review of Pharmacology (U.S.)

Annu. Rev. Phys. Chem.
Annual Review of Physical Chemistry (U.S.)

An. Quim.
Anales de Quimica. Real Sociedad Espanola de Fisica y Quimica (Formerly Anales de la Real Sociedad Espanola de Fisica y Quimica, Serie B. Quimica) (Spain)

An. Stiint. Univ. Al. I. Cuza Iasi, Sect. Ia
Analele Stiintifice ale Universitatii Al. I. Cuza din Iasi, Sectiunea Ia. Matematica (Romania)
Supersedes in part An. Stiint. Univ. Al. I. Cuza Iasi, Sect. I

Antibiotiki
Antibiotiki (U.S.S.R.)

An. Univ. Bucuresti, Chim.
Analele Universitatii Bucuresti, Chimie (Romania)

An. Univ. Bucuresti, Fiz.
Analele Universitatii Bucuresti, Fizica (Romania)
Supersedes An. Univ. Bucuresti, Ser. Stiint. Natur., Fiz.

An. Univ. Timisoara, Ser. Stiinte Fiz.-Chim.
Analele Universitatii din Timisoara, Seria Stiinte Fizice-Chimice (Romania)
Continues in part An. Univ. Timisoara, Ser. Stiinte Mat.-Fiz.

Apl. Mat.
Aplikace Matematiky (Czechoslovakia)

Appl. Entomol. Zool.
Applied Entomology and Zoology (Japan)

Appl. Microbiol.
Applied Microbiology (U.S.)

Appl. Opt.
Applied Optics (U.S.)

Appl. Phys.
Applied Physics (West Germany - U.S.)

Appl. Phys. Lett.
Applied Physics Letters (U.S.)

Appl. Polym. Symp.
Applied Polymer Symposia (supersedes in part Journal of Applied Polymer Science) (U. S.)

Appl. Sci. Res. (The Hague)
Applied Scientific Research (The Hague) (Netherlands)

Appl. Spectrosc.
Applied Spectroscopy (U.S.)

Arbeitsschutz (Cologne)
Arbeitsschutz (Cologne) (West Germany)

Archaeometry
Archaeometry (England)

Arch. Biol. (Liege)
Archives de Biologie (Liege) (Belgium)

Arch. Dermatol. Forsch.
Archiv fuer Dermatologische Forschung (West Germany)
Supersedes Arch. Klin. Exp. Dermatol.

Arch. Elektrotech. (Berlin)
Archiv fuer Elektrotechnik (Berlin) (West Germany)

Arch. Elektrotech. (Warsaw)
Archiwum Elektrotechniki (Warsaw) (Poland)

Arch. Energiewirt.
Archiv fuer Energiewirtschaft (West Germany)

Arch. Entwicklungsmech. Organ.
Archiv fuer Entwicklungsmechanik der Organismen, Wilhelm Roux (West Germany)

Arch. Environ. Health
Archives of Environmental Health (Formerly A.M.A. Archives of Industrial Health) (U.S.)

Arch. Fischereiwiss.
Archiv fuer Fischereiwissenschaft (West Germany)

Arch. Fund. Roux-Ocefa
Archivos de la Fundacion Roux-Ocefa (Argentina)

Arch. Geflugelk.
Archiv fuer Geflugelkunde (West Germany)

Arch. Genet.
Archiv fuer Genetik (Switzerland)
Supersedes Arch. Julius Klaus-Stift. Vererbungsforsch., Sozialanthropol. Rassenhyg.

Arch. Gesam. Virusforsch.
Archiv fuer die Gesamte Virusforschung (Austria)

Arch. Hutn.
Archiwum Hutnictwa (Poland)

Arch. Hydrotech.
Archiwum Hydrotechniki (Poland)

Arch. Immunol. Ther. Exp.
Archivum Immunologiae et Therapiae Experimentalis (Poland)

Arch. Intern. Med.
Archives of Internal Medicine (U.S.)

Arch. Int. Pharmacodyn.
Archives Internationales de Pharmacodynamie et de Therapie (Belgium)

Arch. Int. Physiol. Biochim.
Archives Internationales de Physiologie et de Biochimie (Belgium)

Arch. Lebensmittelhyg.
Archiv fuer Lebensmittelhygiene Insbesondere fuer Fleisch, Fisch, und Milchhygiene (West Germany)

Arch. Mikrobiol.
Archiv fuer Mikrobiologie (West Germany)

Arch. Ophtalmol.
Archives d'Ophtalmologie (France)

Arch. Oral Biol.
Archives of Oral Biology (England)

Arch. Otolaryngol.
Archives of Otolaryngology (U.S.)

Arch. Pathol.
Archives of Pathology (Formerly A.M.A. Archives of Pathology) (U.S.)

Arch. Procesow Spalania
Archiwum Procesow Spalania (Poland)

Arch. Sci. (Geneva)
Archives des Sciences (Geneva) (Switzerland)

Arch. Tech. Mes. Messtech. Praxis
Archiv fuer Technisches Messen und Messtechnische Praxis (West Germany)
Supersedes Arch. Tech. Mes.

Arch. Tech. Mes.
Archiv fuer Technisches Messen und Industrielle Messtechnik (West Germany)
Superseded by Arch. Tech. Mes. Messtech. Praxis

Arch. Toxikol.
Archiv fuer Toxikologie (West Germany)

Arctic
Arctic (U.S. - Canada)

Arerugi
Arerugi (Japanese Journal of Allergy) (Japan)

Arh. Biol. Nauka (Belgrade)
Arhiv Bioloskih Nauka (Belgrade) (Yugoslavia)
For English Translation See Archives of Biological Sciences (Belgrade) (U.S.)

Arh. Hig. Rada Toksikol.
Arhiv za Higijenu Rada i Toksikologiju (Yugoslavia)

Ariz., Univ. Lunar Planet. Lab., Commun.
Arizona, University of. Lunar Planetary Laboratory, Communications (U.S.)

Ark. Fys. Seminar Trondheim
Arkiv for det Fysiske Seminar i Trondheim (Norway)

Arkh. Anat., Gistol. Embriol.
Arkhiv Anatomii, Gistologii i Embriologii (U.S.S.R.)

Arkh. Patol.
Arkhiv Patologii (U.S.S.R.)

Arm. Khim. Zh.
Armyanskii Khimicheskii Zhurnal (Formerly Izvestiya Akademii Nauk Armyanskoi SSR, Khimicheskie Nauk) (Armenian S.S.R.)

Arq. Neuro-Psiquiat
Arquivos de Neuro-Psiquiatria (Brazil)

Arq. Patol. (Lisbon)
Arquivos de Patologia (Lisbon) (Portugal)

Arthritis Rheum.
Arthritis and Rheumatism (U.S.)

Artif. Satell.
Artificial Satellites (Poland)

Arzneim.-Forsch.
Arzneimittel-Forschung. Drug Research (West Germany)

Asahi Garasu Kenkyu Hokoku
Asahi Garasu Kenkyu Hokoku (Reports of the Research Lab., Asahi Glass Co.) (Japan)

Astrometriya Astrofiz.
Astrometriya i Astrofizika (Ukrainian S.S.R.)

Astron. Astrophys.
Astronomy and Astrophysics (Formed by the Merging of Annales d'Astrophysique, Bulletin of the Astronomical Institutes of the Netherlands, Bulletin Astronomique, Journal des Observateurs, and Zeitschrift fuer Astrophysik) (West Germany - U.S.)

Astron. Astrophys., Suppl. Ser.
Astronomy and Astrophysics, Supplement Series (Switzerland)

Astronaut. Acta
Astronautica Acta (Austria)

Astronaut. Aeronaut.
Astronautics and Aeronautics (Formerly Astronautics and Aerospace Engineering) (U.S.)

Astronautik
Astronautik (West Germany)

Astron. J.
Astronomical Journal, The (U.S.)

Astron. Nachr.
Astronomische Nachrichten (East Germany)

Astronomie
Astronomie, L (France)

Astron. Raumfahrt
Astronomie und Raumfahrt (West Germany)

Astron. Vestn.
Astronomicheskii Vestnik (U.S.S.R.)

Astrophysics (Engl. Transl.)
Astrophysics (English Translation of Astrofizika) (U.S.)

Astrophys. J.
Astrophysical Journal, The (U.S.)

Astrophys. J., Lett.
Astrophysical Journal, The, Letters to the Editor (U.S.)

Astrophys. J., Suppl. Ser.
Astrophysical Journal, The, Supplement Series (U.S.)

Astrophys. Lett.
Astrophysical Letters (Scotland)

Astrophys. Space Sci.
Astrophysics and Space Science (Netherlands)

At. Data
Atomic Data (U. S.)

At. Data Nucl. Data Tables
Atomic Data and Nuclear Data Tables (formerly carried under titles: Nucl. Data, Sect. A; and Nucl. Data Tables) (U.S.)

Ateneo Parmense, Sez. 2. Acta Natur.
Ateneo Parmense, L' Sezione 2. Acta Naturalia (Italy)

At. Energ. (USSR)
Atomnaya Energiya (U.S.S.R.)
Issued in English Translation as Soviet Journal of Atomic Energy, The

At. Energy Aust.
Atomic Energy in Australia (Australia)

At. Energy Law J.
Atomic Energy Law Journal (U.S.)

At. Energy Rev.
Atomic Energy Review (Austria)

At. Inform.
Atom Informationen (West Germany)

At. Jap.
Atoms in Japan (Japan)

Atmos. Environ.
Atmospheric Environment (England)

Atom (London)
Atom (London) (England)

Atomkernenergie
Atomkernenergie (Formerly Atomenergie) (West Germany)

ATOMKI (At. Kut. Intez.) Kozlem.
ATOMKI (Atommag Kutato Intezet) Kozlemenyek (Hungary)

ATOMKI (At. Kut. Intez.) Kozlem., Suppl.
ATOMKI (Atommag Kutato Intezet) Kozlemenyek, Supplement (Hungary)

Atomwirt., Atomtech.
Atomwirtschaft, Atomtechnik (Formerly Atomwirtschaft, Die) (West Germany)

Atoomenergie Haar Toepass.
Atoomenergie en Haar Toepassingen (Formerly RCN Bulletin) (Netherlands)

At. Strom
Atom und Strom (West Germany)

At. Tekh. Rubeznom
Atomnaya Tekhnika za Rubezhom (U.S.S.R.)

Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur.
Atti della Accademia Nazionale dei Lincei, Rendiconti, Classe di Scienze Fisiche, Matematiche e Naturali (Italy)

Atti Accad. Sci. Torino. I. Cl. Sci. Fis., Mat. Natur.
Atti della Accademia delle Scienze di Torino. (Part) 1. Classe di Scienze Fisiche, Matematiche e Naturali (Italy)

Atti Notiz. (Publ. in Met. Ital.)
Atti Notizie, Associazione Italiana di Metallurgia (Published in Metallurgia Italiana) (Italy)

Aust. Chem. Eng.
Australian Chemical Engineering (Australia)

Aust. Gemmol.
Australian Gemmologist, The (Australia)

Aust. J. Biol. Sci.
Australian Journal of Biological Sciences (Australia)

Aust. J. Chem.
Australian Journal of Chemistry (Australia)

Aust. J. Forensic Sci.
Australian Journal of Forensic Sciences (Australia)

Aust. J. Phys.
Australian Journal of Physics (Australia)

Aust. J. Phys., Astrophys. Suppl.
Australian Journal of Physics, Astrophysical Supplement (Australia)

Aust. Miner. Ind.
Australian Mineral Industry (Australia)

Aust. N. Z. J. Obstet. Gynaecol.
Australian and New Zealand Journal of Obstetrics and Gynaecology (Australia)

Aust. Phys.
Australian Physicist (Australia)

Aust. Process Eng.
Australian Process Engineering (Australia)

Australas. Bull. Med. Phys. Biophys.
Australasian Bulletin of Medical Physics and Biophysics (Australia)

Australas. Radiol.
Australasian Radiology (Formerly Journal of the College of Radiologists of Australasia) (Australia)

Aust. Weld. J.
Australian Welding Journal (Australia)

Automaz. Strum.
Automazione e Strumentazione (Italy)

Automedica
Automedica (England - U.S.)

Aviat. Week Space Technol.
Aviation Week and Space Technology (U.S.)

Avtomat. Svarka
Avtomaticheskaya Svarka (Ukrainian S.S.R.)
Issued in English Translation as Automatic Welding (USSR)

Azerb. Khim. Zh.
Azerbaidzhanskii Khimicheskii Zhurnal (Azerbaidzhan S.S.R.)

Azerb. Neft. Khoz.
Azerbaidzhanskoe Neftyanoe Khozyaistvo (Azerbaidzhan S.S.R.)

B

Bacteriol. Rev.
Bacteriological Reviews (U.S.)

Banyasz. Kohasz. Lapok, Kohasz.
Banyaszati es Kohaszati Lapok, Kohaszat (Hungary)
Supersedes Kohasz. Lapok

BBC-Nachr.
BBC-Nachrichten (Switzerland)

Behav. Biol.
Behavioral Biology (U.S.)
Continues Commun. Behav. Biol., Part A

Beitr. Gerichtl. Med.
Beitraege zur Gerichtliche Medizin (Austria)

Beitr. Orthop. Traumatol.
Beitraege zur Orthopaedie und Traumatologie (East Germany)

Beitr. Patnol.
Beitraege zur Pathologie (West Germany)
Supersedes Beitraege zur Pathologischen Anatomie und zur Allgemeinen Patnologie

Bell J. Econ. Manage. Sci.
Bell Journal of Economics and Management Science (U.S.)

Ber. Bunsenges. Phys. Chem.
Berichte der Bunsengesellschaft fuer Physikalische Chemie (Formerly Zeitschrift fuer Elektrochemie) (West Germany)

Ber. Deut. Keram. Ges.
Berichte der Deutschen Keramischen Gesellschaft E. V. (West Germany)

Ber. Inform. (Eur. Gemeinsch.)
Berichte und Informationen (Europaeische Gemeinschaften) (West Germany)

Beton Zhelezobeton
Beton i Zhelezobeton (Georgian S.S.R.)

Bibl. Haematol.
Bibliotheca Haematologica, Supplementa ad Acta Haematologica (Switzerland)

Bild Wiss.
Bild der Wissenschaft (West Germany)

Biochem. Biophys. Res. Commun.
Biochemical and Biophysical Research Communications (U.S.)

Biochemistry
Biochemistry (U.S.)

Biochem. J.
Biochemical Journal (England)

Biochem. Med.
Biochemical Medicine (U.S.)

Biochim. Biophys. Acta
Biochimica et Biophysica Acta (Netherlands)

Biofizika
Biofizika (U.S.S.R.)
For English Translation see Biophysics (USSR)

Bioinorg. Chem.
Bioinorganic Chemistry (U.S.)

Biokhimiya
Biokhimiya (U.S.S.R.)
For English Translation see Biochemistry (USSR) (U.S.)

Biol. Gastro-Enterol.
Biologie et Gastro-Enterologie (Supplement to Archives Francaise des Maladies de l'Appareil Digestif) (France)

Biol. Listy
Biologicke Listy (Czechoslovakia)

Biol. Nauki
Biologicheskie Nauki (U.S.S.R.)

Biologia (Bratislava)
Biologia (Bratislava) (Czechoslovakia)

Biol. Plant. (Prague)
Biologia Plantarum (Prague) (Czechoslovakia)

Biol. Reprod.
Biology of Reproduction (U. S.)

Biol. Unserer Zeit
Biologie in Unserer Zeit (West Germany)

Biol. Zh. Arm.
Biologicheskii Zhurnal Armenii (Formerly Izvestiya Akademii Nauk Armyanskoi SSR, Biologicheskie Nauki) (Armenian S.S.R.)

Bio-Med. Eng.
Bio-Medical Engineering (England)

Biomed. Eng. (USSR) (Engl. Transl.)
Biomedical Engineering (USSR) (English Translation of Meditsinskaya Tekhnika) (U.S.)

Biomedicine
Biomedicine (France)
Supersedes Rev. Eur. Etud. Clin. Biol.

Biomed. Tecn.
Biomedizinische Technik (West Germany)

Biophysics (USSR) (Engl. Transl.)
Biophysics (USSR) (English Translation of Biofizika) (England)

Biophysik
Biophysik (West Germany)
Continued as Radiat. Environ. Biophys. with Vol. 11, No. 1, 1974

Biophys. J.
Biophysical Journal (U.S.)

Bioscience
Bioscience (U.S.)

Biotechnol. Bioeng.
Biotechnology and Bioengineering (England)

Bitamin
Bitamin (Vitamins) (Japan)

Blood
Blood. The Journal of Hematology (U.S.)

Blut
Blut. Zeitschrift fuer Gesamte Blutforschung (West Germany)

Bodenkultur
Bodenkultur, Die (Austria)

Boira Kenkyu
Biora Kenkyu (Journal of the Japan Boiler Association) (Japan)

Boll. Ist. Sieroterap. Milan.
Bollettino dell'Istituto Sieroterapica Milanese (Italy)

Boll. Unione Mat. Ital.
Bollettino dell'Unione Matematica Italiana (Italy)

Boll. Zool.
Bollettino di Zoologia. Pubblicato dall'Unione Zoologica Italiana (Italy)

Botanique (Nagpur)
Botanique (Nagpur) (India)

Bot. Bull. Acad. Sinica (Taiwan)
Botanical Bulletin of Academia Sinica (Taiwan) (China)

Bot. Mar.
Botanica Marina (West Germany)

Brain Res.
Brain Research (Netherlands)

Brandschutz
Brandschutz (West Germany)

Bratislav. Lek. Listy
Bratislavske Lekarske Listy (Czechoslovakia)

Brennst.-Waerme-Kraft
Brennstoff-Waerme-Kraft (West Germany)

Brit. Dent. J.
British Dental Journal (England)

Brit. Engine Tech. Rep.
British Engine Technical Reports (England)

Brit. J. Cancer
British Journal of Cancer (England)

Brit. J. Dermatol.
British Journal of Dermatology (England)

Brit. J. Haematol.
British Journal of Haematology (England)

Brit. J. Ind. Med.
British Journal of Industrial Medicine (England)

Brit. J. Non-Destruct. Test.
British Journal of Non-Destructive Testing (England)

Brit. J. Ophthalmol.
British Journal of Ophthalmology (England)

Brit. J. Prev. Soc. Med.
British Journal of Preventive And Social Medicine (England)

Brit. J. Radiol.
British Journal of Radiology (England)

Brit. J. Surg.
British Journal of Surgery, The (England)

Brit. J. Urol.
British Journal of Urology, The (Scotland)

Brit. Med. Bull.
British Medical Bulletin (England)

Brit. Med. J.
British Medical Journal, The (England)

Brown Boveri Rev.
Brown Boveri Review (Switzerland)

Bruns Beitr. Klin. Chir.
Bruns Beitraege zur Klinischen Chirurgie (West Germany)

BSI News
BSI (British Standards Institution) News (England)

Bul. Inst. Politeh. Gheorghe Gheorghiu-Dej Bucuresti
Buletinul Institutului Politehnic Gheorghe Gheorghiu-Dej Bucuresti (Romania)

Bull. Acad. Pol. Sci., Ser. Sci. Biol.
Bulletin de l'Academie Polonaise des Sciences, Serie des Sciences Biologiques (Poland)

Bull. Acad. Pol. Sci., Ser. Sci. Chim.
Bulletin de l'Academie Polonaise des Sciences, Serie des Sciences Chimiques (Poland)

Bull. Acad. Pol. Sci., Ser. Sci., Math., Astron. Phys.
Bulletin de l'Academie Polonaise des Sciences, Serie des Sciences, Mathematiques, Astronomiques et Physiques (Poland)

Bull. Acad. Pol. Sci., Ser. Sci. Tech.
Bulletin de l'Academie Polonaise des Sciences, Serie des Sciences Techniques (Poland)

Bull. Acad. Sci., USSR, Div. Chem. Sci. (Engl. Transl.)
Bulletin of the Academy of Sciences, USSR, Division of Chemical Science (English Translation of Izvestiya Akademii Nauk SSSR, Seriya Khimicheskaya) (U.S.)

Bull. Acad. Sci. USSR, Phys. Ser. (Engl. Transl.)
Bulletin of the Academy of Sciences of the USSR, Physical Series (English Translation of Izvestiya Akademii Nauk SSSR, Seriya Fizicheskaya) (U.S.)

Bull. Amer. Math. Soc.
Bulletin of the American Mathematical Society (U.S.)

Bull. Amer. Meteorol. Soc.
Bulletin of the American Meteorological Society (U.S.)

Bull. Astron. Inst. Czech.
Bulletin of the Astronomical Institutes of Czechoslóvakia (Czechoslovakia)

Bull. At. Sci.
Bulletin of the Atomic Scientists (U.S.)

Bull. Chem. Soc. Jap.
Bulletin of the Chemical Society of Japan (Japan)

Bull. Cl. Sci., Acad. Roy. Belg.
Bulletin de la Classe des Sciences, Academie Royale de Belgique (Belgium)

Bull. Dir. Etud. Rech., Ser. A
Bulletin de la Direction des Etudes et Recherches, Serie A (France)

Bull. Dir. Etud. Rech., Ser. B
Bulletin de la Direction des Etudes et Recherches, Serie B (France)

Bull. Droit Nucl.
Bulletin de Droit Nucleaire (France)

Bull. EGU
Bulletin EGU (Vyzkumny Ustav Energeticky) (Czechoslovakia)

Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.)
Bulletin d'Information A.T.E.N. (Association Technique pour l'Energie Nucleaire) (France)

Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.), Suppl.
Bulletin d'Information A.T.E.N. (Association Technique pour l'Energie Nucleaire), Supplement (France)

Bull. Inform. CETAMA
Bulletin d'Information de la CETAMA (France)

Bull. Inform. Sci. Tech. (Paris)
Bulletin d'Information Scientifique et Technique (Paris) (France)

Bull. Inst. Chem. Res., Kyoto Univ.
Bulletin of the Institute for Chemical Research, Kyoto University (Japan)

Bull. Kyoto Educ. Univ., Ser. B
Bulletin of the Kyoto Educational University, Series B. Mathematics and Natural Science (Japan)

Bull. Los Angeles Neurol. Soc.
Bulletin of the Los Angeles Neurological Society (U.S.)

Bull. Math. Biol.
Bulletin of Mathematical Biology (U.S.)
Supersedes Bull. Math. Biophys.

Bull. Ophthalmol. Soc. Egypt
Bulletin of the Ophthalmological Society of Egypt (Egypt)

Bull. Sci., Cons. Acad. Sci. Arts RSF Yougoslavie, Sect. A
Bulletin Scientifique, Conseil des Academies des Sciences et des Arts de la RSF de Yougoslavie, Section A. Sciences Naturelles, Techniques et Medicales (Yugoslavia)

Bull. Seismol. Soc. Amer.
Bulletin of the Seismological Society of America (U.S.)

Bull. Soc. Chim. Belg.
Bulletin des Societes Chimiques Belges (Belgium)

Bull. Soc. Chim. Fr.
Bulletin de la Societe Chimique de France (France)

Bull. Soc. Fr. Ceram.
Bulletin de la Societe Francaise de Ceramique (France)

Bull. Soc. Fr. Miner. Cryst.
Bulletin de la Societe Francaise de Mineralogie et de Cristallographie (France)

Bull. Soc. Int. Chir.
Bulletin de la Societe Internationale de Chirurgie (Belgium)

Bull., Soc. Roy. Belge Elec.
Bulletin, Societe Royale Belge des Electriciens (Belgium)

Bull. Soc. Roy. Bot. Belg.
Bulletin de la Societe Royale de Botanique de Belgique (Belgium)

Bull. Soc. Roy. Sci. Liege
Bulletin de la Societe Royale des Sciences de Liege (Belgium)

Bull. Tokyo Inst. Technol. (Engl. Ed.)
Bulletin of the Tokyo Institute of Technology (English Edition) (Not the same publication as Tokyo Kogyo Daigaku Gakuho) (Japan)

Bull. Union Physiciens
Bulletin de l'Union des Physiciens (France)

Bull. Univ. Osaka Prefect., Ser. A
Bulletin of the University of Osaka Prefecture, Series A (Japan)

Bull. Vet. Inst. Pulawy
Bulletin of the Veterinary Institute in Pulawy (Poland)

Bull. World Health Organ.
Bulletin of the World Health Organization (U.S.)

Bundesgesundheitsblatt
Bundesgesundheitsblatt (West Germany)

Bunko Kenkyu
Bunko Kenkyu (Journal of the Spectroscopical Society of Japan) (Japan)

Bunseki Kiki
Bunseki Kiki (Analytical Instruments) (Japan)

Butsuri Tanko
Butsuri Tanko (Geophysical Exploration) (Japan)

Byull. Eksp. Biol. Med.
Byulleten Eksperimental'noi Biologii i Meditsiny (U.S.S.R.)
For English Translation see Bulletin of Experimental Biology and Medicine (USSR)

C

Calcified Tissue Res.
Calcified Tissue Research (West Germany)

Californium-252 Progr.
Californium-252 Progress (U. S.)

Calore
Calore, Il (Italy)

CAMAC Bull.
CAMAC Bulletin (Luxembourg)

Cancer
Cancer (U.S.)

Cancer Chemother. Rep.
Cancer Chemotherapy Reports (U.S.)

Cancer Res.
Cancer Research (U.S.)

Can. Chem. Process.
Canadian Chemical Processing (Canada)

Can. Contr. Instrum.
Canadian Controls and Instrumentation (Canada)

Can. Entomol.
Canadian Entomologist, The (Canada)

Can. Field Natur.
Canadian Field Naturalist (Canada)

Can. Inst. Food Sci. Technol. J.
Canadian Institute of Food Science and Technology Journal (Canada)
Supersedes Can. Inst. Food Technol. J.

Can. Inst. Food Technol. J.
Canadian Institute of Food Technology Journal (Canada)
Changed to Can. Inst. Food Sci. Technol. J.

Can. J. Bot.
Canadian Journal of Botany (Canada)

Can. J. Chem.
Canadian Journal of Chemistry (Canada)

Can. J. Earth Sci.
Canadian Journal of Earth Sciences (Canada)

Can. J. Genet. Cytol.
Canadian Journal of Genetics and Cytology (Canada)

Can. J. Microbiol.
Canadian Journal of Microbiology (Canada)

Can. J. Phys.
Canadian Journal of Physics (Canada)

Can. J. Spectrosc.
Canadian Journal of Spectroscopy (Canada)
Supersedes Can. Spectrosc.

Can. J. Zool.
Canadian Journal of Zoology (Canada)

Can. Mach. Metalwork.
Canadian Machinery and Metalworking (Canada)

Can. Med. Ass. J.
Canadian Medical Association Journal, The (Canada)

Can. Met. Quart.
Canadian Metallurgical Quarterly (Canada)

Can. Mining J.
Canadian Mining Journal (Incorporates Mining in Canada) (Canada)

Can. Mining Met. Bull.
Canadian Mining and Metallurgical Bulletin, The (Canada)
Superseded by CIM (Can. Mining Met.) Bull.

Can. Res. Develop.
Canadian Research and Development (Formerly Canadian Nuclear Technology) (Canada)

Carbonyd. Res.
Carbohydrate Research (Netherlands)

Carbon
Carbon (England)

Caries Res.
Caries Research (Switzerland)

Case Stud. At. Phys.
Case Studies in Atomic Physics (Netherlands)

Cas. Lek. Cesk.
Casopis Lekaru Ceskych (Czechoslovakia)

Celestial Mech.
Celestial Mechanics (Netherlands)

Cell Differentiation
Cell Differentiation (Netherlands)

Cell. Immunol.
Cellular Immunology (U.S.)

Cell Tissue Kinet.
Cell and Tissue Kinetics (England)

Cellul. Chem. Technol.
Cellulose Chemistry and Technology (Romania)

CERN Cour.
CERN Courier (Switzerland)

Cesk. Cas. Fys.
Ceskoslovensky Casopis pro Fysiku (Czechoslovakia)

Cesk. Farm.
Ceskoslovenska Farmacie (Czechoslovakia)

Cesk. Fysiol.
Ceskoslovenska Fysiologie (Czechoslovakia)

Cesk. Gynekol.
Ceskoslovenska Gynekologie (Czechoslovakia)

Cesk. Hyg.
Ceskoslovenska Hygiena (Czechoslovakia)

Cesk. Otolaryngol.
Ceskoslovenska Otolaryngologie (Czechoslovakia)

Cesk. Radiol.
Ceskoslovenska Radiologie (Formerly Ceskoslovenska Rentgenologie) (Czechoslovakia)

Cesk. Stomatol.
Ceskoslovenska Stomatologie (Czechoslovakia)

Ceylon Vet. J.
Ceylon Veterinary Journal (Ceylon)

Chagyo Gijutsu Kenkyu
Chagyo Gijutsu Kenkyu (Study of Tea) (Japan)

Chem. Anal. (Warsaw)
Chemia Analityczna (Warsaw) (Poland)

Chem.-Anlagen Verfahren
Chemie-Anlagen und Verfahren (West Germany)

Chem. Eng. J. (Lausanne)
Chemical Engineering Journal (Lausanne) (Switzerland)

Chem. Eng. News
Chemical Engineering News (U.S.)

Chem. Eng. Progr.
Chemical Engineering Progress (U.S.)

Chem. Eng. Sci.
Chemical Engineering Science (England)

Chem. Geol.
Chemical Geology (Netherlands)

Chemiefasern Text.-Anwendungstech./Text. Ind.
Chemiefasern und Textil-Anwendungstechnik/Textil-Industrie (West Germany)

Chem. Ind. (London)
Chemistry and Industry (London) (England)

Chem.-Ing.-Tech.
Chemie-Ingenieur-Technik (West Germany)

Chem. Lett. (Tokyo)
Chemistry Letters (Tokyo) (Japan)

Chem. Listy
Chemicke Listy (Czechoslovakia)

Chem. Pharm. Bull. (Tokyo)
Chemical and Pharmaceutical Bulletin (Tokyo) (Japan)

Chem. Phys. (Amsterdam)
Chemical Physics (Amsterdam) (Netherlands)

Chem. Phys. Lett.
Chemical Physics Letters (Netherlands)

Chem. Phys. Lipids
Chemistry and Physics of Lipids (Netherlands)

Chem. Rev.
Chemical Reviews (U.S.)

Chem. Soc. Rev.
Chemical Society Reviews (England)
Formed by merger of Quart. Rev., Chem. Soc. and RIC (Roy. Inst. Chem.) Rev.

Chem. Ztg.
Chemiker Zeitung (West Germany)
Superseded by Chem.-Ztg., Chem. App.; changed back to Chem.-Ztg.

Chem.-Ztg., Chem. App.
Chemiker-Zeitung, Chemische Apparatur (West Germany)
Formerly Chem.-Ztg.; changed back to Chem.-Ztg.

Chem. Zvesti
Chemicke Zvesti (Czechoslovakia)

Chesapeake Sci.
Chesapeake Science (U.S.)

Chigaku Zasshi
Chigaku Zasshi (Journal of Geography) (Japan)

Chikyu Kagaku
Chikyu Kagaku (Earth Science) (Japan)

Chimia (Aarau)
Chimia (Aarau) (Switzerland)

Chim. Ind. (Milan)
Chimica e l'Industria, La (Milan) (Italy)

Chin. J. Phys. (Taiwan)
Chinese Journal of Physics (Taiwan) (China)

Chirurg
Chirurg, Der (West Germany)

Chirurgia (Bucharest)
Chirurgia (Bucharest) (Romania)

Chishitsu Chosasho Geppo
Chishitsu Chosasho Geppo (Bulletin of the Geological Survey of Japan) (Japan)

Chishitsugaku Zasshi
Chishitsugaku Zasshi (Journal of the Geological Society of Japan) (Japan)

Chislennye Metody Mekh. Sploshnoi Sredy
Chislennye Metody Mekhaniki Sploshnoi Sredy (U.S.S.R.)

Chlodnictwo
Chlodnictwo (Poland)

Cho-Koon Kenkyu
Cho-Koon Kenkyu (Japan)

Chromatographia
Chromatographia (West Germany)

Chubu Denryoku K. K. Kenkyu Shiryo
Chubu Denryoku K. K. Kenkyu Shiryo (Memoirs of the Chubu Electric Power Co., Ltd.) (Japan)

Ciel Terre
Ciel et Terre (Belgium)

Cienc. Cult. (Sao Paulo)
Ciencia e Cultura (Sao Paulo) (Brazil)

CIM (Can. Mining Met.) Bull.
CIM (Canadian Mining and Metallurgy) Bulletin (Formerly Canadian Mining and Metallurgy Bulletin) (Canada)

Circulation
Circulation (U.S.)

Clay Miner.
Clay Minerals (England)

Clin. Allergy
Clinical Allergy (England)

Clin. Biochem.
Clinical Biochemistry (Canada)

Clin. Chem.
Clinical Chemistry (U.S.)

Clin. Chim. Acta
Clinica Chimica Acta (Netherlands)

Clin. Exp. Immunol.
Clinical and Experimental Immunology (England)

Clin. Immunol. Immunopathol.
Clinical Immunology and Immunopathology (U.S.)

Clin. Obstet. Gynecol.
Clinical Obstetrics and Gynecology (U.S.)

Clin. Orthop.
Clinical Orthopaedics (U.S.)
Superseded by Clinical Orthopaedics and Related Research

Clin. Radiol.
Clinical Radiology (Scotland)

Clin. Sci. Mol. Med.
Clinical Science and Molecular Medicine (England)
Supersedes Clin. Sci.

Coal Age
Coal Age (U.S.)

Collect. Czech. Chem. Commun.
Collection of Czechoslovak Chemical Communications (Czechoslovakia)

Colo. Sch. Mines, Miner. Ind. Bull.
Colorado School of Mines, Mineral Industries Bulletin (U.S.)

Colourage
Colourage (India)

Combustion
Combustion (U.S.)

Combust. Sci. Technol.
Combustion Science and Technology (U. S.-England)

Commentat. Biol.
Commentationes Biologicae, Societas Scientiarum Fennica (Finland)

Comments Astrophys. Space Phys.
Comments on Astrophysics and Space Physics (England - U. S.)

Comments At. Mol. Phys.
Comments on Atomic and Molecular Physics (England - U. S.)

Comments Earth Sci., Geophys.
Comments on Earth Sciences, Geophysics (England)

Comments Nucl. Particle Phys.
Comments on Nuclear and Particle Physics (England - U. S.)

Commun. Math. Phys.
Communications in Mathematical Physics (West Germany)

Com. Naz. Energ. Nucl., Notiz.
Comitato Nazionale per l'Energia Nucleare, Notiziario (Italy)

Composites
Composites (England)

Compt. Rend., Ser. A, B
Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, Series A, et B (France)
Series A, B issued separately as Compt. Rend., Ser. A, and Compt. Rend., Ser. B

Compt. Rend., Ser. A
Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, Serie A (France)
Supersedes in part Compt. Rend., Ser. A, B

Compt. Rend., Ser. B
Comptes Rendus Hebdomadaires de Seances de l'Academie des Sciences, Serie B (France)
Supersedes in part Compt. Rend., Ser. A, B

Compt. Rend., Ser. C
Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, Serie C (France)

Compt. Rend., Ser. D
Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, Serie D (France)

Compt. Rend. Acad. Bulg. Sci.
Comptes Rendus de l'Academie Bulgare des Sciences (Bulgarie)

Compt. Rend. Soc. Biol.
Comptes Rendus des Seances de la Societe de Biologie et de ses Filiales (France)

Comput. Phys. Commun.
Computer Physics Communications (Netherlands)

Comput. Programs Biomed.
Computer Programs in Biomedicine (Netherlands)

Confin. Neurol.
Confinia Neurologica Borderland of Neurology (Switzerland)

Conf. Remote Syst. Technol., Proc.
Conference on Remote Systems Technology, Proceedings (U.S.)

Consult. Eng.
Consulting Engineer (England)

Contemp. Phys.
Contemporary Physics (England)

Contr. Instrum.
Control and Instrumentation (Formerly Control and Automation Process) (England)

Corrosion
Corrosion (U.S.)

Cosmic Res. (USSR) (Engl. Transl.)
Cosmic Research (USSR) (English Translation of Kosmicneskie Issledovaniya) (U.S.)

CRC Crit. Rev. Anal. Chem.
CRC Critical Reviews in Analytical Chemistry (U. S.)

CRC Crit. Rev. Environ. Contr.
CRC Critical Reviews in Environmental Control (U. S.)

CRC Crit. Rev. Toxicol.
CRC Critical Reviews in Toxicology (U.S.)

Croat. Chem. Acta
Croatica Chemica Acta (Yugoslavia)

Cryogenics
Cryogenics (England)

Cryog. Ind. Gases
Cryogenic and Industrial Gases (formerly Cryogenic Engineering News) (U.S.)

Cryst. Lattice Defects
Crystal Lattice Defects (Northern Ireland)

Curr. Eng. Pract.
Current Engineering Practice (India)

Curr. Sci. (India)
Current Science (India)

Curr. Top. Exp. Endocrinol.
Current Topics in Experimental Endocrinology (U.S.)

Curr. Top. Radiat. Res.
Current Topics in Radiation Research (Netherlands)
Superseded by Curr. Top. Radiat. Res. Quart.

Curr. Top. Radiat. Res. Quart.
Current Topics in Radiation Research Quarterly (Netherlands)
Supersedes Curr. Top. Radiat. Res.

Cytobiologie
Cytobiologie (West Germany)

Cytobios
Cytobios (England)

Cytologia (Tokyo)
Cytologia (Tokyo) International Journal of Cytology (Japan)

Czas. Stomatol.
Czasopismo Stomatologiczne (Poland)

CZ-Chem.-Tech.
CZ-Chemie-Technik (Supplement to Chem. Ztg.)

Czech. J. Phys.
Czechoslovak Journal of Physics (Czechoslovakia)

D

Daehan Hwahak Hwoejee
Daehan Hwahak Hwoejee (Journal of the Korean Chemical Society) (South Korea)

DAtF Sonderdrucke
DAtF (Deutsches Atomforum e.V.) Sonderdrucke (West Germany)

Deep-Sea Res. Oceanogr. Abstr.
Deep-Sea Research and Oceanographic Abstracts (Formerly Deep-Sea Research) (England)

Def. Sci. J. (New Delhi)
Defence Science Journal (New Delhi) (India)

Delft Progr. Rep., Ser. A-F
Delft Progress Report, Series A - F (Netherlands)
Pilot issue; Ser. A through F issued separately

Delft Progr. Rep., Ser. A
Delft Progress Report, Series A. Chemistry and Physics, Chemical and Physical Engineering (Netherlands)
Supersedes in part Delft Progr. Rep., Ser. A-F

Delft Progr. Rep., Ser. B
Delft Progress Report, Series B. Electrical, Electronic and Information Engineering (Netherlands)
Supersedes in part Delft Progr. Rep., Ser. A-F

Dengen Kaihatsu K.K., Chosa Shiryo
Dengen Kaihatsu K.K., Chosa Shiryo (Research Bulletin of Electric Power Development Co., Ltd.) (Japan)

Denki Gakkai Ronbunshi, A
Denki Gakkai Ronbunshi, A (Japan)

Denki Kagaku
Denki Kagaku (Journal of the Electrochemical Society of Japan) (Japan)
Changed to Denki Kagaku Oyobi Kogyo Butsuri Kagaku

Denki Kyokai Zasshi
Denki Kyokai Zasshi (Journal of the Japan Electric Association) (Japan)

Denki Tsushin Kenkyusho Kenkyu Jitsuyoka Hokoku
Denki Tsushin Kenkyusho Kenkyu Jitsuyoka Hokuku (Electrical Communication Lab., Technical Journal) (Japan)

Denpa Kenkyusho Kiho
Denpa Kenkyusho Kiho (Review of the Radio Research Laboratory) (Japan)

Denryoku Chuo Kenkyusho Gijutsu Kenkyusho Hokoku
Denryoku Chuo Kenkyusho Gijutsu Kenkyusho Hokoku (Technical Laboratory, Central Research Institute of Electrical Power Industry, Report) (Japan)

Denshi Gijutsu Sogo Kenkyusho Iho
Denshi Gijutsu Sogo Kenkyusho Iho (Japan)

Denshi Gijutsu Sogo Kenkyusho Kenkyu Hokoku
Denshi Gijutsu Sogo Kenkyusho Kenkyu Hokoku (Research Report of the Electronics General Research Institute) (Japan)

Dent. As.
Dental Assistant, The (U.S.)

Desalination
Desalination (Netherlands)

Des. Eng. (Toronto)
Design Engineering (Toronto) (Canada)

Deut. Gesundheitsw.
Deutsche Gesundheitswesen, Das (West Germany)

Deut. Lebensm.-Rundsch.
Deutsche Lebensmittel-Rundschau (West Germany)

Deut. Med. Wochenschr.
Deutsche Medizinische Wochenschrift. (West Germany)
Issued in English language edition as German Medical Monthly

Deut. Stomatol.
Deutsche Stomatologie (East Germany)

Deut. Tieraerztl. Wochenschr.
Deutsche Tieraerztlich Wochenschrift (West Germany)

Develop. Ind. Sci.
Developpement Industriel et Scientifique (France)

Develop. Psychobiol.
Developmental Psychobiology (U. S.)

Diamond Res.
Diamond Research (England)

Doboku Gakkai Ronbun Hokokushu
Doboku Gakkai Ronbun Hokokushu (Japan)

Dokl. Akad. Nauk Arm. SSR
Doklady Akademii Nauk Armyanskoi SSR (Armenian S.S.R.)

Dokl. Akad. Nauk Azerb. SSR
Doklady Akademii Nauk Azerbaidzhanskoi SSR (Azerbaidzhan S.S.R.)

Dokl. Akad. Nauk BSSR
Doklady Akademii Nauk BSSR (Belorussian S.S.R.)

Dokl. Akad. Nauk SSSR
Doklady Akademii Nauk SSSR (U.S.S.R.)
Issued in English Translation by Sections

Dokl. Akad. Nauk Tadzh. SSR
Doklady Akademii Nauk Tadzhikskoi SSR (Tadznik S.S.R.)

Dokl. Akad. Nauk Uzb. SSR
Doklady Akademii Nauk Uzbekskoi SSR (Uzbek S.S.R.)

Dokl. Biochem. (Engl. Transl.)
Doklady Biochemistry (English Translation of Doklady Akademii Nauk SSSR, Biochemistry Section) (U.S.)

Dokl. Biol. Sci.
Doklady Biological Sciences (Translation of Dokl. Akad. Nauk SSSR, Biological Sciences Sections) (U.S.)

Dokl. Chem.
Doklady Chemistry (Translation of Dokl. Akad. Nauk SSSR, Chemistry Section) (U.S.)

Dokl. Phys. Chem.
Doklady Physical Chemistry (Translation of Dokl. Akad. Nauk SSSR, Physical Chemistry Section) (U.S.)

Dokumenteshon Kenkyu
Dokumenteshon Kenkyu (Japan)

Dopov. Akad. Nauk Ukr. RSR, Ser. A
Dopovidi Akademii Nauk Ukrains'koi RSR, Seriya A Fiziko-Tekhnichni ta Matematichni Nauki (Supersedes in Part Dopovidi Akademii Nauk Ukrains'koi RSR) (Ukrainian S.S.R.)

Dopov. Akad. Nauk Ukr. RSR, Ser. B
Dopovidi Akademii Nauk Ukrains'koi RSR, Seriya B Geologiia, Geofizika, Khimiya na Biologiya (Supersedes In Part Dopovidi Akademii Nauk Ukrains'koi RSR) (Ukrainian S.S.R.)

Doryokuro Giho
Doryokuro Giho (Japan)

E

Earth Extraterr. Sci.
Earth and Extraterrestrial Sciences (England)

Earth Planet. Sci. Lett.
Earth and Planetary Science Letters (Netherlands)

Ecologist
Ecologist (England)

Ecology
Ecology (U.S.)

Econ. Geol.
Economic Geology and the Bulletin of the Society of Economic Geologists (U.S.)

EEI (Edison Elec. Inst.) Bull.
EEI (Edison Electric Institute) Bulletin (U.S.)

Egypt. J. Genet. Cytol.
Egyptian Journal of Genetics and Cytology (Egypt)

Ehara Jiho
Ehara Jiho (Ebara Times) (Japan)

Eisei Kagaku
Eisei Kagaku (The Journal of Hygienic Chemistry) (Japan)

Eisei Shikenjo Hokoku
Eisei Shikenjo Hokoku (Bulletin of National Institute of Hygenic Sciences) (Japan)

Eiyo To Shokuryo
Eiyo To Shokuryo (Journal of Japanese Society of Food and Nutrition) (Japan)

Eksp. Med. Morfol.
Eksperimentalna Meditsina i Morfologiya (Bulgaria)

Ekspress-Inform., Ser.: Reg., Razved. Prom. Geofiz.
Ekspress-Informatsiya, Seriya: Regional'naya, Razvedochnaya i Promyslovaya Geofizika (U.S.S.R.)
26

ELDO/ESRO Sci. Tech. Rev.
ELDO/ESRO Scientific and Technical Review (France)

Elec.-Electron. Mod.
Electricite-Electronique Moderne (France)

Elec. Eng. (Sydney)
Electrical Engineer (Sydney) (Australia)

Elec. India
Electrical India (India)

Elec. Light Power, E/G Ed.
Electric Light and Power, E/G (Energy/Generation) Edition (U.S.)
Supersedes in part Elec. Light Power (Boston)

Elec. Light Power, T/D Ed.
Electric Light and Power, T/D (Transmission/Distribution) Edition (U.S.)
Supersedes in part Elec. Light Power (Boston)

Elec. Rev.
Electrical Review (England)

Electricite
Electricite (Belgium)

Elektro
Elektro (Norway)
Supersedes Elektroteknisk Tidsskrift

Electrochim. Acta
Electrochimica Acta (England)

Electromedica
Electromedica (West Germany)

Electron. Appl. Bull.
Electronic Applications Bulletin (Netherlands)
Supersedes Electron. Appl.

Electron. Lett.
Electronics Letters (England)

Electron. Microeletron. Ind.
Electronique et Microelectronique Industrielles (France)

Electron. Power
Electronics and Power (England)

Electron Technol.
Electron Technology (Poland)

Electrotehnica (Bucharest)
Electrotehnica (Bucharest) (Romania)

Elec. World
Electrical World (U.S.)

Elektrizitaetswirtschaft
Elektrizitaetswirtschaft (West Germany)

Elektrokhimiya
Elektrokhimiya (U.S.S.R.)

Elektronik (Munich)
Elektronik (Munich) (West Germany)

Elektron. Obrab. Mater.
Elektronnaya Obrabotka Materialov (Moldavian S.S.R.)

Elektroprom. Priborostr.
Elektropromishlenost i Priborostroene (Bulgaria)

Elektrotech. Cas.
Elektrotechnicky Casopis (Czechoslovakia)

Elektrotech. Obz.
Elektrotechniky Obzor (Czechoslovakia)

Elektrotech. Z., B
Elektrotechnische Zeitschrift, B (West Germany)

Elettrotecnica
Elettrotecnica, L' (Italy)

EMO (Emergency Meas. Organ.) Dig.
EMO (Emergency Measures Organization) Digest (Canada)

Endeavour
Endeavour (England)

Endocrinol. Exp.
Endocrinologia Experimentalis (Czechoslovakia)

Endocrinol. Jap.
Endocrinologia Japonica (Japan)

Endocrinology
Endocrinology (U.S.)

Endokrynol. Pol.
Endokrynologia Polska (Poland)

Energ. Atomtech.
Energia es Atomtechnika (Hungary)

Energ. Elek.
Energetika i Elektrifikatsiya (Ukrainian S.S.R.)

Energetika
Energetika (Czechoslovakia)

Energie
Energie (West Germany)

Energiewirt. Tagesfragen
Energiewirtschaftliche Tagesfragen (West Germany)

Energ. Nucl. (Madrid)
Energia Nuclear (Madrid) (Spain)

Energ. Nucl. (Milan)
Energia Nucleare (Milan) (Italy)

Energ. Nucl. (Paris)
Energie Nucleaire (Paris) (France)

Energ. Tech.
Energie und Technik (West Germany)

Energy Convers.
Energy Conversion (Formerly Advanced Energy Conversion) (England)

Energy Int.
Energy International (U.S.)

Energy Policy
Energy Policy (England)

Energy Sources
Energy Sources (U.S.)

Eng. Dig. (Toronto)
Engineering Digest (Toronto) (Canada)

Engei Gakkai Zasshi
Engei Gakkai Zasshi (Journal of the Japanese Society for Horticultural Science) (Japan)

Eng. Fracture Mech.
Engineering Fracture Mechanics (England)

Engineering
Engineering (England)

Eng. J. (Montreal)
Engineering Journal, The (Montreal) (Canada)

Eng. Mining J.
Engineering and Mining Journal (U.S.)

Entomol. Exp. Appl.
Entomologia Experimentalis et Applicata (Netherlands)

Entropie
Entropie (France)

Environ. Aff.
Environmental Affairs (U.S.)

Environ. Change
Environment and Change (England)
Ceased publication

Environ. Entomol.
Environmental Entomology (U.S.)

Environ. Lett.
Environmental Letters (U.S.)

Environ. Physiol. Biochem.
Environmental Physiology and Biochemistry (Denmark)
Supersedes Environ. Physiol.

Environ. Pollut. (London)
Environmental Pollution (London) (England)

Environ. Res.
Environmental Research (U.S.)

Environ. Sci. Technol.
Environmental Science and Technology (U. S.)

EOS, Trans., Amer. Geophys. Union
EOS, Transactions, American Geophysical Union (U.S.)
Supersedes Trans. Amer. Geophys. Union

EPPO Bull.
EPPO (European and Mediterranean Plant Protection Organization) Bulletin (France)

ERA (Foeren. Elek. Ration. Anvaendning)
ERA (Foereningen foer Elektricitetens Rationella Anvaendning) (Sweden)

Erdoel Kohle, Erdgas, Petrochem.
Erdoel und Kohle, Erdgas, Petrochemie (West Germany)

Erzmetall
Erzmetall (West Germany)
Supersedes Z. Erzbergbau Metallhuettenw.

Eur. J. Biochem.
European Journal of Biochemistry (Formerly Biochemische Zeitschrift) (West Germany)

Eur. J. Cancer
European Journal of Cancer (England)

Eur. J. Immunol.
European Journal of Immunology (West Germany)

Euro-Spectra
Euro-Spectra. Scientifical and Technical Review of the European Communities (Formerly Euratom Review) (Belgium)

Eur. Polym. J.
European Polymer Journal (England)

Eur. Surg. Res.
European Surgical Research (Switzerland)

Exp. Cell Res.
Experimental Cell Research (U.S.)

Experientia
Experientia (Switzerland)

Exp. Gerontol.
Experimental Gerontology (England)

Exp. Hematol.
Experimental Hematology (Denmark)

Exp. Mech.
Experimental Mechanics (U.S.)

Exp. Parasitol.
Experimental Parasitology (U.S.)

Exp. Tech. Phys.
Experimentelle Technik der Physik (East Germany)

F

FAPIG (Tokyo)
FAPIG (Tokyo) (Japan)

Faraday Spec. Discuss. Chem. Soc.
Faraday Special Discussions of the Chemical Society (England)

Farbe Lack
Farbe und Lack (West Germany)

Farmaco (Pavia) Ed. Prat.
Farmaco, Il (Pavia), Edizione Pratica (Italy)

Farmakol. Toksikol.
Farmakologiya i Toksikologiya (U.S.S.R.)
Issued In English Translation as Pharmacology and Toxicology (USSR)

Farm. Obz.
Farmaceuticky Obzor (Czechoslovakia)

Fauna (Oslo)
Fauna (Oslo) (Norway)

FEBS (Fed. Eur. Biochem. Soc.) Lett.
FEBS (Federation of European Biochemical Societies) Letters (Netherlands)

Fed. Proc.
Federation Proceedings (U.S.)

Fed. Regist. (Wash., D.C.)
Federal Register (Washington, D.C.) (U.S.)

Ferroelectrics
Ferroelectrics (England)

Fert. Steril.
Fertility and Sterility (U.S.)

Fields Quanta
Fields and Quanta (England)

Fire Eng. J.
Fire Engineers Journal (England)

Fisken Havet
Fisken og Havet (Norway)

Fiz. Elektron.
Fizicheskaya Elektronika (U.S.S.R.)

Fiz. Elektron., Mosk. Inzh.-Fiz. Inst.
Fizicheskaya Elektronika, Moskovskii Inzhenerno-Fizicheskii Institut (U.S.S.R.)

Fizika (Zagreb)
Fizika (Zagreb) (Yugoslavia)

Fiziol. Aktiv. Veshchestva
Fiziologicheski Aktivnye Veshchestva (Ukrainian S.S.R.)

Fiziol. Zh., Akad. Nauk Ukr. RSR
Fiziologichnii Zhurnal, Akademiya Nauk Ukrainskoi RSR (Ukrainian S.S.R.)

Fiz.-Khim. Mekh. Mater.
Fiziko-khimicheskaya Mekhanika Materialov (Ukrainian S.S.R.)
Issued in English translation as Soviet Materials Science

Fiz. Khim. Obrab. Mater.
Fizika i Khimiya Obrabotki Materialov (U.S.S.R.)

Fiz. Metal. Metalloved.
Fizika Metallov i Metallovedeniya, Akademiya Nauk SSSR, Ural'skii Filial (U.S.S.R.)
For English Translation see The Physics of Metals and Metallography (USSR)

Fiz. Plazmy Probl. Upr. Termoyad. Sin.
Fizika Plazmy i Problemy Upravlyaemogo Termoyadernogo Sinteza (Ukrainian S.S.R.)

Fluid Dyn. (USSR) (Engl. Transl.)
Fluid Dynamics (USSR) (English Translation of Izvestiya Akademii Nauk SSSR, Mekhanika Zhidkosti i Gaza) (U.S.)

Fluid Mech. - Sov. Res.
Fluid Mechanics - Soviet Research (U.S.)

Folia Biol. (Krakow)
Folia Biologica (Krakow) (Poland)

Folia Biol. (Prague)
Folia Biologica (Prague) (Czechoslovakia)

Folia Fac. Med. Univ. Comenianae Bratislav.
Folia Facultatis Medicae Universitatis Comenianae Bratislaviensis (Czechoslovakia)

Folia Haematol. (Leipzig)
Folia Haematologia (Leipzig) (East Germany)

Folia Med. (Sofia)
Folia Medica (Sofia) (Bulgaria)

Folia Microbiol. (Prague)
Folia Microbiologica (Prague) (Czechoslovakia)

Folia Morphol. (Prague)
Folia Morphologica (Prague) (Czechoslovakia)

Folia Vet.
Folia Veterinaria (Czechoslovakia)

Food Cosmet. Toxicol.
Food and Cosmetics Toxicology (England)

Food Eng. (Philadelphia)
Food Engineering (Philadelphia) (Formerly Food Industries) (U.S.)

Food Ind. S. Afr.
Food Industries of South Africa (South Africa)

Food Irradiat. Inform.
Food Irradiation Information (West Germany)

Forskningsnytt
Forskningsnytt (Norway)

Fortschr. Chem. Forsch.
Fortschritte der Chemischen Forschung (West Germany)

Fortschr. Geb. Roentgenstr. Nuklearmed.
Fortschritte auf dem Gebiete der Roentgenstrahlen und der Nuklearmedizin (West Germany)

Fortschr. Med.
Fortschritte der Medizin (West Germany)

Fortschr. Phys.
Fortschritte der Physik (East Germany)

Forum (Chicago)
Forum, The (Chicago) (U.S.)

Found. Phys.
Foundations of Physics (U.S.)

Fra Fys. Verden
Fra Fysikkens Verden (Norway)

Fridericiana
Fridericiana (West Germany)

Fuel
Fuel. A Journal of Fuel Science (England)

Fuji Jiho
Fuji Jiho (The Fuji Electric Journal) (Japan)

Fujusnima Daigaku Kyoikugakubu Rika Hokoku
Fukushima Daigaku Kyoikugakubu Rika Hokoku (Science Reports of the Faculty of Education, Fukushima University) (Japan)

Fukui Daigaku Kogakubu Kenkyu Hokoku
Fukui Daigaku Kogakubu Kenkyu Hokoku (Memoirs of the Faculty of Engineering, Fukui University) (Japan)

Funtai Oyobi Funmatsuyakin
Funtai Oyobi Funmatsuyakin (Journal of the Japan Society of Powder and Powder Metallurgy) (Japan)

Fys. Tidsskr.
Fysisk Tidsskrift (Denmark)

Fyz. Cas.
Fyzikalny Casopis, Vydavatel'stvo Slovenskej Akademie Vied (Czechoslovakia)
Superseded by Acta Phys. Slovaca

G

Gamma Field Symp.
Gamma Field Symposia, Ibaraki (Japan)

Ganka
Ganka (Ophthalmology) (Japan)

Ganka Rinsho Iho
Ganka Rinsho Iho (Japan)

Gann
Gann (Japan)

Gan No Rinsho
Gan No Rinsho (Japanese Journal of Cancer Clinics) (Japan)

Ganseki Kobutsu Kosho Gakkaishi
Ganseki Kobutsu Kosho Gakkaishi (The Journal of the Japanese Association of Mineralogists, Petrologists and Economic Geologists) (Japan)

Gartenbauwissenschaft
Gartenbauwissenschaft (West Germany)

Gastroenterology
Gastroenterology (U.S.)

Gaz, Woda Tech. Sanit.
Gaz, Woda i Technika Sanitarna (Poland)

Geburtsn. Frauenheilk.
Geburtsnilfe und Frauenheilkunde (West Germany)

G.E.C. J. Sci. Technol.
G.E.C. Journal of Science and Technology (England)
Changed to G.E.C.-A.E.I. Journal of Science and Technology

Geka Shinryo
Geka Shinryo (Japan)

Geliotekhnika
Geliotekhnika (Uzbek S.S.R.)
Issued in English translation as Applied Solar Energy (USSR)

Gemeinsames Ministerialbl., A
Gemeinsames Ministerialblatt, A (West Germany)

Gen. Comp. Endocrinol.
General and Comparative Endocrinology (U.S.)

Gendai Igaku
Gendai Igaku (Current Medicine) (Japan)

Genen Phaenen
Genen en Phaenen (Netherlands)

Genet. Agr.
Genetica Agraria (Italy)

Genetics
Genetics (U.S.)

Genetics, Suppl.
Genetics, Supplement (U.S.)

Genetika
Genetika (U.S.S.R.)
Issued in English Translation as Soviet Genetics

Genet. Selek.
Genetika i Selektsiya (Bulgaria)

Genet. Slechteni
Genetika a Slechteni (Czechoslovakia)

Gen. Relativity Gravitation
General Relativity and Gravitation (England)

Genshiryoku Chosa Jiho
Genshiryoku Chosa Jiho (Review of Atomic Industries) (Japan)

Genshiryoku Hakusho
Genshiryoku Hakusho (Japan)

Genshiryoku Iinkai Geppo
Genshiryoku Iinkai Geppo (Journal of Atomic Energy Commission) (Japan)

Genshiryoku Kogyo
Genshiryoku Kogyo (Nuclear Engineering) (Japan)

Genshiryokusen
Genshiryokusen (Nuclear Ships) (Japan)

Geochem. J. (Nagoya)
Geochemical Journal (Nagoya) (Japan)

Geochim. Cosmochim. Acta
Geochimica et Cosmochimica Acta (England)

Geofiz. App.
Geofizicheskaya Apparatura (U.S.S.R.)

Geofiz. Sb.
Geofizicheskii Sbornik (Ukrainian S.S.R.)

Geofys. Sb.
Geofysikalni Sbornik (Czechoslovakia)

Geokhimiya
Geokhimiya (U.S.S.R.)
Selected Articles Appear in English Translation in Geochemistry International

Geol. Jahrb.
Geologisches Jahrbuch (west Germany)

Geol. Jahrb., Reihe C
Geologisches Jahrbuch, Reihe C. Hydrogeologie, Ingenieurgeologie (West Germany)
Supersedes in part Geol. Jahrb.

Geol. Pruzkum
Geologicky Pruzkum (Czechoslovakia)

Geol. Rud. Mestorozhd.
Geologiya Rudnykh Mestorozhdenii, Akademiya Nauk SSSR (U.S.S.R.)

Geol. Soc. Amer., Bull.
Geological Society of America, Bulletin (U.S.)

Geol. Soc. Amer., Mem.
Geological Society of America, Memoir (U.S.)

Geol. Surv. Can., Pap.
Geological Survey of Canada, Paper (Canada)

Geol. Zh. (Russ. Ed.)
Geologicheskii Zhurnal (Russian Edition) (Ukrainian S.S.R.)

Geomagn. Aeron. (USSR) (Engl. Transl.)
Geomagnetism and Aeronomy (USSR) (English Translation of Geomagnetizm i Aeronomiya) (U.S.)

Geotechnique
Geotechnique (England)

Geotherm. Energy Mag.
Geothermal Energy Magazine (title varies: Geothermal Energy Magazine; Geothermal Energy) (U.S.)

Geothermics
Geothermics (U.S. - Italy)

Gerlands Beitr. Geophys.
Gerlands Beitraege zur Geophysik (Formerly carried as Beitraege zur Geophysik, Gerlands) (East Germany)

Ger. Med.
German Medicine (West Germany)
Supersedes Ger. Med. Mon. Discontinued

G. Fis. Sanit. Prot. Radiaz.
Giornale di Fisica Sanitaria e Protezione Contro le Radiazioni (Italy)

Giessereipraxis
Giessereipraxis (West Germany)

Gig. Sanit.
Gigiena i Sanitariya (U.S.S.R.)
Issued in English Translation as Hygiene and Sanitation (USSR)

Gig. Tr. Prof. Zabol.
Gigiena Truda i Professional'nye Zabolevaniya (U.S.S.R.)

G-I-T (Glas- Instrum.-Tech.) Fachz. Lab.
G-I-T (Glas- und Instrumenten-Technik) Fachzietschrift fuer das Laboratorium (West Germany)

God. Sofii. Univ., Biol. Fak.
Godishnik na Sofiiskiya Universitet, Biologicheski Fakultet (Bulgaria)

God. Sofii. Univ., Fiz. Fak.
Godishnik na Sofiiskiya Universitet, Fizicheski Fakultet (Bulgaria)

Gorn. Zh.
Gornyi Zhurnal (U.S.S.R.)

Gorskostop. Nauka
Gorskostopanska Nauka (Yugoslavia)

Gradinar. Lozar. Nauka
Gradinarska i Lozarska Nauka (Yugoslavia)

Gravitatsiya Teor. Otnositel'nosti
Gravitatsiya i Teoriya Otnositel'nosti (U.S.S.R.)

Groenlands Geol. Unders. Rap.
Groenlands Geologiske Undersoegelse Rapport (Denmark)

Growth
Growth (U.S.)

Gummi, Asbest, Kunstst.
Gummi, Asbest, Kunststoffe (West Germany)

H

Haematol. Bluttransfus.
Haematologie und Bluttransfusion (Suppl. to Blut) (West Germany)

Haematologia (Budapest)
Haematologia (Budapest) (Hungary)

Haematologica (Pavia)
Haematologica (Pavia) (Italy)

Haigan
Haigan (Japan)

Haikan Gijutsu
Haikan Gijutsu (The Piping Engineering) (Japan)

Handelsblatt
Handelsblatt (West Germany)

Han'guk Sikp'um Kwahakhoe Chi
Han'guk Sikp'um Kwahakhoe Chi (Journal of the Korean Society of Food Science and Technology) (South Korea)

Harefuah
Harefuah (Israel)

Hautarzt
Hautarzt, Der (Austria)

Health Phys.
Health Physics (England)

Heat., Piping Air Cond.
Heating, Piping and Air Conditioning (U.S.)

Heat Transfer - Jap. Res.
Heat Transfer - Japanese Research (U.S.)

Heat Transfer - Sov. Res.
Heat Transfer - Soviet Research (U.S.)

Helgolaender Wiss. Meeresunters.
Helgolaender Wissenschaftliche Meeresuntersuchungen (West Germany)

Helv. Chim. Acta
Helvetica Chimica Acta (Switzerland)

Helv. Paediat. Acta
Helvetica Paediatrica Acta (Switzerland)

Helv. Phys. Acta
Helvetica Physica Acta (Switzerland)

Herion-Inform.
Herion-Informationen (West Germany)

Heron (Engl. Ed.)
Heron (English Edition) (Netherlands)

Hifu
Hifu (Skin Research) (Japan)

High Energy Chem. (USSR) (Engl. Transl.)
High Energy Chemistry (USSR) (English Translation of Khimiya Vysokikh Energiya) (U. S.)

High Temp. (USSR) (Engl. Transl.)
High Temperature (USSR) (English Translation of Teplofizika Vysokikh Temperatur) (U. S.)

High Temp. - High Pressures
High Temperatures - High Pressures. International Journal of Research (England)

High Temp. Sci.
High Temperature Science. An International Journal (U.S. - England)

Hihakai Kensa
Hihakai Kensa (Journal of NDI) (Japan)

Himeji Kogyo Daigaku Kenkyu Hokoku
Himeji Kogyo Daigaku Kenkyu Hokoku (Reports of the Himeji Inst. of Technology) (Japan)

Hinyokika Kiyo
Hinyokika Kiyo (Acta Urologica Japonica) (Japan)

Hippokrates (Stuttgart)
Hippokrates (Stuttgart) (West Germany)

Hirosaki Daigaku Nogakubu Gakujutsu Hokoku
Hirosaki Daigaku Nogakubu Gakujutsu Hokoku (Bulletin of the Faculty of Agriculture, Hirosaki University) (Japan)

Hiroshima Daigaku Genbaku Hoshano Igaku Kenkyusho Nenpo
Hiroshima Daigaku Genbaku Hoshano Igaku Kenkyusho Nenpo (Proceedings of the Research Institute for Nuclear Medicine and Biology, Hiroshima University) (Japan)

Hiroshima Igaku
Hiroshima Igaku (Journal of the Hiroshima Medical Association) (Japan)

Histochemie
Histochemie (West Germany)

Hitachi Hyoron
Hitachi Hyoron (The Hitachi Review) (Japan)

Hodowla Rosl., Aklim. Nasien.
Hodowla Roslin, Aklimatyzacja i Nasiennictwo (Poland)

Hoken Butsuri
Hoken Butsuri (Journal of Japan Health Physics Society) (Japan)

Hokkaidoritsu Eisei Kenkyusnoho
Hokkaidoritsu Eisei Kenkyushoho (Report of the Hokkaido Inst. of Public Health) (Japan)

Honvedorvos
Honvedorvos (Hungary)

Horm. Metab. Res.
Hormone and Metabolic Research (West Germany)

Horumon To Rinsho
Horumon To Rinsho (Clinical Endocrinology) (Japan)

Hosnasen Ikushujo Kenkyu Hokoku
Hoshasen Ikushujo Kenkyu Hokoku (Japan)

Hosnasen Kagaku
Hosnasen Kagaku (Japan)

Hosnasen Riyo Tokei
Hoshasen Riyo Tokei (Japan)

Hoshasen Seibutsu Kenkyu
Hoshasen Seibutsu Kenkyu (Japan)

Hospitals
Hospitals (U. S.)

Hosp. Pract.
Hospital Practice (U.S.)

Houille Blanche
Houille Blanche, La (France)

Hrana Ishrana
Hrana i Ishrana (Yugoslavia)

Hua Hseuh Tung Pao
Hua Hseuh Tung Pao (Chemical Bulletin) (China)
Ceased Publication

Hum. Biol.
Human Biology (U.S.)

Hutn. Listy
Hutnicke Listy (Czechoslovakia)

I

Ideen Exakten Wissens
Ideen des Exakten Wissens. Wissenschaft und Technik in der Sowjetunion (West Germany)

Ideggyogy. Szemle
Ideggyogyaszati Szemle (Hungary)

Iden
Iden (Heredity) (Japan)

IEEE J. Quant. Electron.
IEEE (Institute of Electrical and Electronics Engineers), Journal of Quantum Electronics (U.S.)

IEEE Spectrum
IEEE (Institute of Electrical and Electronics Engineers), Spectrum (U.S.)

IEEE Trans. Aerospace
Electron. Syst.
IEEE (Institute of Electrical and Electronics Engineers), Transactions on Aerospace and Electronics Systems (U.S.)

IEEE Trans. Antennas
Propagation
IEEE (Institute of Electrical and Electronics Engineers), Transactions on Antennas and Propagation (U.S.)

IEEE Trans. Magnet.
IEEE (Institute of Electrical and Electronics Engineers), Transactions on Magnetics (U.S.)

IEEE Trans. Nucl. Sci.
IEEE (Institute of Electrical and Electronics Engineers), Transactions on Nuclear Science (Formerly IRE (Institute of Radio Engineers), Transactions on Nuclear Science) (U.S.)

IEEE Trans. Power App. Syst.
IEEE (Institute of Electrical and Electronics Engineers), Transactions on Power Apparatus and Systems (U.S.)

IFF (Inst. Festkoerperforsch.) Bull.
IFF (Institut fuer Festkoerperforschung, Kernforschungsanlage) Bulletin (West Germany)

Igaku Kenkyu
Igaku Kenkyu (Acta Medica) (Fukouka) (Japan)

Igaku No Ayumi
Igaku No Ayumi (Progress in Medicine) (Japan)

Igaku To Seibutsugaku
Igaku To Seibutsugaku (Medicine and Biology) (Japan)

Igiena (Bucharest)
Igiena (Bucharest) (Romania)

Ikakikaigaku Zasshi
Ikakikaigaku Zasshi (The Journal of Japanese Medical Instruments) (Japan)

Ill. Med. J.
Illinois Medical Journal (U. S.)

Immunology
Immunology (England)

Ind.-Anz.
Industrie-Anzeiger (West Germany)

Ind. At. Spatiales
Industries Atomiques et Spatiales (France)
Supersedes Ind. At. and Sci. Ind. Spatiales, beginning Jan. 1972

Ind. Chim. Belge
Industrie Chimique Belge (Belgium)

Ind. Diamond Rev.
Industrial Diamond Review (England)

Ind. Eng. Chem., Process Design Develop.
Industrial and Engineering Chemistry, Process Design and Development (U.S.)

Indian East. Eng.
Indian and Eastern Engineer, the (Incorporating the Far Eastern Engineer and Indian and Eastern Motors) (India)

Indian Eng.
Indian Engineer (India)

Indian Food Packer
Indian Food Packer (India)

Indian J. Agr. Sci.
Indian Journal of Agricultural Science, The (India)

Indian J. Anim. Sci.
Indian Journal of Animal Sciences (India)
Supersedes Indian J. Vet. Sci. Anim. Husb.

Indian J. Appl. Chem.
Indian Journal of Applied Chemistry (India)

Indian J. Biochem. Biophys.
Indian Journal of Biochemistry and Biophysics (India)
Continues Indian J. Biochem.

Indian J. Chem.
Indian Journal of Chemistry (India)

Indian J. Chem. Educ.
Indian Journal of Chemical Education (India)

Indian J. Dairy Sci.
Indian Journal of Dairy Science (India)

Indian J. Environ. Health
Indian Journal of Environmental Health (India)
Supersedes Environ. Health

Indian J. Exp. Biol.
Indian Journal of Experimental Biology (India)

Indian J. Genet. Plant Breed.
Indian Journal of Genetics and Plant Breeding (India)

Indian J. Med. Res.
Indian Journal of Medical Research, The (India)

Indian J. Med. Sci.
Indian Journal of Medical Sciences (India)

Indian J. Meteorol. Geophys.
Indian Journal of Meteorology and Geophysics (India)

Indian J. Nutr. Diet.
Indian Journal of Nutrition and Dietetics (India)

Indian J. Occup. Health
Indian Journal of Occupational Health (India)

Indian J. Phys.
Indian Journal of Physics and Proceedings of The Indian Association for the Cultivation of Science (India)

Indian J. Power River Valley Develop.
Indian Journal of Power and River Valley Development (India)

Indian J. Pure Appl. Math.
Indian Journal of Pure and Applied Mathematics (India)

Indian J. Pure Appl. Phys.
Indian Journal of Pure and Applied Physics (India)

Indian J. Radiol.
Indian Journal of Radiology (India)

Indian J. Radio Space Phys.
Indian Journal of Radio and Space Physics (India)

Indian J. Technol.
Indian Journal of Technology (Formerly Journal of Scientific and Industrial Research (India), Section D) (India)

Indian J. Theor. Phys.
Indian Journal of Theoretical Physics (India)

Indian J. Zootomy
Indian Journal of Zootomy (India)

Ind. Lab. (USSR) (Engl. Transl.)
Industrial Laboratory (USSR) (English Translation of Zavodskaya Laboratoriya) (U.S.)

Ind. Miner.
Industrie Minerale (France)
Supersedes Revue de l'Industrie Minerale and Mines et Chimie

Ind. Miner. (London)
Industrial Minerals (London) (England)

Ind. Water Eng.
Industrial Water Engineering (U.S.)

Inform. Quim. Anal., Pura Apl. Ind.
Informacion de Quimica Analitica, Pura y Aplicada a la Industria (Spain)

Infrared Phys.
Infrared Physics. An International Research Journal (England)

Ing.-Dig.
Ingenieur-Digest (West Germany)

Ingenieur (Montreal)
Ingenieur, L (Montreal) (Canada)

Ingenieursblad
Ingenieursblad (Belgium)

Ingenieur (Utrecht)
Ingenieur, De (Utrecht) (Netherlands)

Ingenioer-nytt
Ingenioer-nytt (Norway)

Ing. Nucl.
Ingegneria Nucleare (Italy)

Inorg. Chem.
Inorganic Chemistry (U.S.)

Inorg. Chim. Acta
Inorganica Chimica Acta (Italy)

Inorg. Mater. (USSR) (Engl. Transl.)
Inorganic Materials (USSR) (English Translation of Izvestiya Akademii Nauk SSSR, Neorganicheskie Materialy) (U.S.)

Inorg. Nucl. Chem. Lett.
Inorganic and Nuclear Chemistry Letters (England-U.S.)

Inst. Mining Met., Trans./Sect. B
Institution of Mining and Metallurgy, Transactions/Section B. Applied Earth Science (Continues in Part Transactions of the Institution of Mining and Metallurgy) (England)

Inst. Mining Met., Trans., Sect. C
Institution of Mining and Metallurgy, Transactions, Section C. Mineral Processing and Extractive Metallurgy (England)
Continues in part Trans. Inst. Mining Met.

Instrum. Exp. Tech. (USSR) (Engl. Transl.)
Instruments and Experimental Techniques (USSR) (English Translation of Pribory i Tekhnika Eksperimenta) (U.S.)

Instrum. India
Instruments India (India)

Instrum. Technol.
Instrumentation Technology (Formerly ISA (Instrument Society of America) Journal) (U.S.)

Int. Arch. Allergy Appl. Immunol.
International Archives of Allergy and Applied Immunology (Switzerland)

Int. Astron. Union Symp.
International Astronomical Union Symposium (Netherlands)

Int. At. Energy Agency Bull.
International Atomic Energy Agency Bulletin (Austria)

Int. Chem. Eng.
International Chemical Engineering. A Quarterly Journal of Translations from Russia, Eastern Europe, and Asia (U.S.)

Int. Comp. Law Quart.
International and Comparative Law Quarterly, The (England)

Int. Dig. Health Legislation
International Digest of Health Legislation (Switzerland)

Int. J. Appl. Radiat. Isotop.
International Journal of Applied Radiation and Isotopes (England)

Int. J. Contr.
International Journal of Control (England)

Int. J. Electron.
International Journal of Electronics (Formerly Journal of Electronics and Control) (England)

Int. J. Eng. Sci.
International Journal of Engineering Science (England)

Int. J. Environ. Stud.
International Journal of Environmental Studies, The (England)

Int. J. Fracture
International Journal of Fracture (Netherlands)
Supersedes International Journal of Fracture Mechanics

Int. J. Heat Mass Transfer
International Journal of Heat and Mass Transfer (England)

Int. J. Magn.
International Journal of Magnetism (England - U. S.)

Int. J. Neurosci.
International Journal of Neuroscience (England)

Int. J. Nucl. Med. Biol.
International Journal of Nuclear Medicine and Biology (England)

Int. J. Parasitol.
International Journal for Parasitology (England)

Int. J. Powder Met. Powder Technol.
International Journal of Powder Metallurgy and Powder Technology (U.S.)
Supersedes Int. J. Powder Met.

Int. J. Pressure Vessels Piping
International Journal of Pressure Vessels and Piping (England)

Int. J. Quant. Chem.
International Journal of Quantum Chemistry (U.S.)

Int. J. Quant. Chem., Symp.
International Journal of Quantum Chemistry, Symposium (U.S.)

Int. J. Radiat. Biol.
International Journal of Radiation Biology and Related Studies in Physics, Chemistry and Medicine (England)

Int. J. Radiat. Phys. Chem.
International Journal for Radiation Physics and Chemistry (England)

Int. J. Rock Mech. Mining Sci.
International Journal of Rock Mechanics and Mining Sciences (U.S. - England)

Int. J. Theor. Phys.
International Journal of Theoretical Physics (England)

Int. J. Vitam. Nutr. Res.
International Journal for Vitamin and Nutrition Research (Switzerland)
Supersedes Int. Z. Vitaminforsch.

Intra-Sci. Chem. Rep.
Intra-Science Chemistry Reports (U.S.)

Int. Surg.
International Surgery (U.S.)

Invest. Ophthalmol.
Investigative Ophtnalmology (U.S.)

Invest. Radiol.
Investigative Radiology (U.S.)

Inzh.-Fiz. Zh.
Inzhenerno-Fizicheskii Zhurnal (Formerly Inzhenerno-Fizicheskii Zhurnal, Akademii Nauk Belorusskoi SSR) (Belorussian S.S.R.)

Irish J. Med. Sci.
Irish Journal of Medical Science (Ireland)

IRS Mitt.
IRS (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine) Mitteilungen (West Germany)

Iryo
Iryo (Medical Treatment) (Japan)

Ishikawajima-Harima Gino
Ishikawajima-Harima Giho (Ishikawajima-Harima Engineering Review) (Japan)

Isotopenpraxis
Isotopenpraxis (East Germany)

Isotope Radiat. Res.
Isotope and Radiation Research (Egypt)

Israel J. Chem.
Israel Journal of Chemistry (Supersedes Bulletin of the Research Council of Israel, Section A Chemistry) (Israel)

Israel J. Med. Sci.
Israel Journal of Medical Sciences (Israel)

Issue (Adelaide)
Issue (Adelaide) (Australia)

Istanbul Univ. Fen Fak. Mecm., Seri C
Istanbul Universitesi Fen Fakultesi Mecmuasi, Seri C Astronomi-Fizik (Turkey)

ISU Mitt.
ISU Mitteilungen (West Germany)

Iugoslav. Physiol. Pharmacol. Acta
Iugoslavica Physiologica et Pharmacologica Acta (Yugoslavia)

Iwate Daigaku Nogakubu Hokoku
Iwate Daigaku Nogakubu Hokoku (Journal of the Faculty of Agriculture, Iwate University) (Japan)

Iwate Igaku Zasshi
Iwate Igaku Zasshi (Journal o the Iwate Medical Association) (Japan)

Iyo Denshi To Seitai Kogaku
Iyo Denshi To Seitai Kogaku (Nippon M-E Gakkai Zasshi) (Japanese Journal of Medical Electronics and Biological Engineering) (Japan)

Izotoptechnika
Izotoptechnika (Hungary)
Supersedes Atomtech. Tajek.

Izotopy SSSR
Izotopy v SSSR (U.S.S.R.)

Izv. Akad. Nauk Arm. SSR, Ser. Fiz.
Izvestiya Akademii Nauk Armyanskoi SSR, Seriya Fizika (Formerly part of Izvestiya Akademii Nauk Armyanskoi SSR, Seriya Fiziko-Matematicheskikh Nauk) (Armenian S.S.R.)

Izv. Akad. Nauk Arm. SSR, Ser. Tekh. Nauk
Izvestiya Akademii Nauk Armyanskoi SSR, Seriya Tekhnicheskikh Nauk (Armenian S.S.R.)

Izv. Akad. Nauk Est. SSR, Fiz. Mat.
Izvestiya Akademii Nauk Estonskoi SSR, Fizika Matematika (Estonian S.S.R.) (Formerly a Part of Izvestiya Akademii Nauk Estonskoi SSR, Seriya Fiziko-Matematicheskikh i Tekhnicheskikh Nauk) (Estonian S.S.R.)

Izv. Akad. Nauk Est. SSR, Khim. Geol.
Izvestiya Akademii Nauk Estonskoi SSR, Khimiya Geologiya (Estonian S.S.R.) (Formerly a Part of Izvestiya Akademii Nauk Estonskoi SSR, Seriya Fiziko-Matematicheskikh i Tekhnicheskikh Nauk) (Estonian S.S.R.)

Izv. Akad. Nauk Kaz. SSR, Ser. Biol.
Izvestiya Akademii Nauk Kazakhskoi SSR, Seriya Biologicheskaya (Formerly Izvestiya Akademii Nauk Kazakhskoi SSR, Seriya Biologicheskikh Nauk) (Kazakh S.S.R.)

Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.
Izvestiya Akademii Nauk Kazakhskoi SSR, Seriya Fiziko-Matematicheskaya (Formerly Izvestiya Akademii Nauk Kazakhskoi SSR, Seriya Fiziko-Matematicheskikh Nauk) (Kazakh S.S.R.)

Izv. Akad. Nauk SSSR, Fiz. Atmos. Okeana
Izvestiya Akademii Nauk SSSR, Fizika Atmosfery i Okeana (U.S.S.R.)

Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza
Izvestiya Akademii Nauk SSSR, Mekhanika Zhidkosti i Gaza (U.S.S.R.)
Issued in English Translation as Soviet Fluid Mechanics; later changed to Fluid Dynamics (USSR)

Izv. Akad. Nauk SSSR, Metal.
Izvestiya Akademiya Nauk SSSR, Metally (Formerly Izvestiya Akademiya Nauk SSSR, Metallurgiya, Gornoe Delo) (U.S.S.R.)
Issued in English Translation as Russian Metallurgy

Izv. Akad. Nauk SSSR, Ser. Biol.
Izvestiya Akademii Nauk SSSR, Seriya Biologicheskaya (U.S.S.R.)

Izv. Akad. Nauk SSSR, Ser. Fiz.
Izvestiya Akademii Nauk SSSR, Seriya Fizicheskaya (U.S.S.R.)
Issued in English Translation as Bull. Acad. Sci., USSR, Phys. Ser.

Izv. Akad. Nauk SSSR, Ser. Geol.
Izvestiya Akademii Nauk SSSR, Seriya Geologicheskaya (U.S.S.R.)

Izv. Akad. Nauk Turkm. SSR, Ser. Fiz.-Tekh., Khim. Geol. Nauk
Izvestiya Akademii Nauk Turkmenskoi SSR, Seriya Fiziko-Tekhnicheskikh, Khimicheskikh i Geologicheskikh Nauk (Turkmen S.S.R.)

Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk
Izvestiya Akademii Nauk Uzbekskoi SSR, Seriya Fiziko-Matematicheskikh Nauk (Uzbek S.S.R.)

Izv. Fiz. Inst. Aneb, Bulg. Akad. Nauk.
Izvestiya na Fizicheskiya Institut s Aneb, Bulgarska Akademiya na Naukite (Bulgaria)

Izv. Geofiz. Inst., Bulg. Akad. Nauk.
Izvestiya na Geofizichniya Institut, Bulgarska Akademiya na Naukite, Otdelenie a Matematicheski i Fizicheski Nauki (Bulgaria)

Izv. Inst. Khidrol. Meteorol., Bulg. Akad. Nauk.
Izvestiya na Instituta po Khidrologiya i Meteorologiya, Bulgarska Akademiya na Naukite, Otdelenie za Matematicheski i Fizicheski Nauki (Bulgaria)

Izv. Krym. Astrofiz. Observ.
Izvestiya Krymskoi Astrofizicheskoi Observatorii (U.S.S.R.)

Izv. Mikrobiol. Inst., Bulg. Akad. Nauk.
Izvestiya na Mikrobiologicheskiya Institut, Bulgarska Akademiya na Naukite (Bulgaria)

Izv. Sekts. Astron., Bulg. Akad. Nauk.
Izvestiya na Sektsiyata po Astronomiya, Bulgarska Akademiya na Naukite (Bulgaria)

Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk
Izvestiya Sibirskogo Otdeleniya Akademii Nauk SSSR, Seriya Khimicheskikh Nauk (U.S.S.R.)
Issued in English Translation as Siberian Chemistry Journal

Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Tekh. Nauk
Izvestiya Sibirskogo Otdeleniya Akademii Nauk SSSR, Seriya Tekhnicheskikh Nauk (U.S.S.R.)

Izv. Tomsk. Politekh. Inst.
Izvestiya Tomskogo Politekhnicheskogo Instituta imeni S. M. Kirova (U.S.S.R.)

Izv. Vyssh. Ucheb. Zaved., Chern. Met.
Izvestiya Vysshikh Uchebnykh Zavedenii, Chernaya Metallurgiya (U.S.S.R.)

Izv. Vyssh. Ucheb. Zaved., Fiz.
Izvestiya Vysshikh Uchebnykh Zavedenii, Fizika (U.S.S.R.)
Issued in English translation as Soviet Physics Journal

Izv. Vyssh. Ucheb. Zaved., Geol. Razved.
Izvestiya Vysshikh Uchebnykh Zavedenii, Geologiya i Razvedka (U.S.S.R.)

Izv. Vyssh. Ucheb. Zaved., Gorn. Zh.
Izvestiya Vysshikh Uchebnykh Zavedenii, Gornyi Zhurnal (U.S.S.R.)

Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Teknol.
Izvestiya Vysshikh Uchebnykh Zavedenii, Khimiya i Khimicheskaya Teknnologiya (U.S.S.R.)

Izv. Vyssh. Ucheb. Zaved., Neft Gaz
Izvestiya Vysshikh Uchebnykh Zavedenii, Neft i Gaz (Azerbaidzhan S.S.R.)

Izv. Vyssh. Ucheb. Zaved., Radiofiz.
Izvestiya Vysshikh Uchebnykh Zavedenii, Radiofizika (U.S.S.R.)
Issued in English Translation as Soviet Radiophysics

Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.
Izvestiya Vysshikh Uchebnykh Zavedenii, Tsvetnaya Metallurgiya (U.S.S.R.)

J

J. Acoust. Soc. Amer.
Journal of the Acoustical Society of America (U.S.)

Jad. Energ.
Jaderna Energie (Czechoslovakia)

J. Adhes.
Journal of Adhesion (U.S.)

J. Aeronaut. Soc. India
Journal of The Aeronautical Society of India (India)

J. Aerosol Sci.
Journal of Aerosol Science (England)

J. Agr. Food Chem.
Journal of Agricultural and Food Chemistry (U.S.)

Jahrb. Oberflaechentech.
Jahrbuch Oberflaechentechnik (West Germany)

J. Air Pollut. Contr. Ass.
Journal of the Air Pollution Control Association (U.S.)

J. Amer. Ceram. Soc.
Journal of The American Ceramic Society (U.S.)

J. Amer. Chem. Soc.
Journal of The American Chemical Society (U.S.)

J. Amer. Dent. Ass.
Journal of The American Dental Association, The (U.S.)

J. Amer. Med. Ass.
Journal of The American Medical Association (U.S.)

J. Amer. Oil Chem. Soc.
Journal of The American Oil Chemists Society, The (U.S.)

J. Amer. Vet. Med. Ass.
Journal of The American Veterinary Medical Association, The (U.S.)

J. Anat.
Journal of Anatomy (England)

J. Anim. Sci.
Journal of Animal Science (U.S.)

Jap. Anal.
Japan Analyst (Bunseki Kagaku) (Japan)

Jap. J. Appl. Phys.
Japanese Journal of Applied Physics (Japan)

Jap. J. Pharmacol.
Japanese Journal of Pharmacology, The (Japan)

J. Appl. Bacteriol.
Journal of Applied Bacteriology (England)

J. Appl. Chem. Biotechnol.
Journal of Applied Chemistry and Biotechnology (England)
Supersedes J. Appl. Chem. (London)

J. Appl. Chem. USSR (Engl. Transl.)
Journal of Applied Chemistry of the USSR (English Translation of Zhurnal Prikladnoi Khimii) (U.S.)

J. Appl. Crystallogr.
Journal of Applied Crystallography (Denmark)

J. Appl. Meteorol.
Journal of Applied Meteorology (U.S.)

J. Appl. Phys.
Journal of Applied Physics (U.S.)

J. Appl. Physiol.
Journal of Applied Physiology (U.S.)

J. Appl. Polym. Sci.
Journal of Applied Polymer Science (U.S.)

J. Ass. Offic. Anal. Chem.
Journal of the Association of Official Analytical Chemists (Formerly Journal of the Association of Official Agricultural Chemists) (U.S.)

J. Atmos. Terrest. Phys.
Journal of Atmospheric and Terrestrial Physics (Northern Ireland)

J. Aust. Ceram. Soc.
Journal of the Australian Ceramic Society (Australia)

J. Aust. Inst. Metals
Journal of the Australian Institute of Metals (Australia)

J. Bacteriol.
Journal of Bacteriology (U.S.)

J. Belge Radiol.
Journal Belge de Radiologie (Belgium)

J. Biol. Chem.
Journal of Biological Chemistry, The (U.S.)

J. Biol. Med. Nucl.
Journal de Biologie et de Medecine Nucleaires. Supplement au Bulletin d'Information A.T.E.N. (Association Technique pour l'Energie Nucleaire) (France)

J. Bone Joint Surg.
Journal of Bone and Joint Surgery, The (England)

J. Brit. Astron. Ass.
Journal of the British Astronomical Association (England)

J. Brit. Nucl. Energy Soc.
Journal of the British Nuclear Energy Society, The (Formerly Journal of the British Nuclear Energy Conference) (England)

J. Cell. Physiol.
Journal of Cellular Physiology (Formerly Journal of Cellular and Comparative Physiology) (U.S.)

J. Cell Sci.
Journal of Cell Science (England)

J. Chem. Educ.
Journal of Chemical Education (U.S.)

J. Chem. Eng. Data
Journal of Chemical and Engineering Data (U.S.)

J. Chem. Phys.
Journal of Chemical Physics, The (U.S.)

J. Chem. Soc., B
Journal of The Chemical Society (London), B. Physical Organic (Formerly a Part of Journal of The Chemical Society (London)) (England)
Superseded by J. Chem. Soc., Perkin Trans., II

J. Chem. Soc., Chem. Commun.
Journal of the Chemical Society (London), Chemical Communications (England)
Supersedes J. Chem. Soc., D

J. Chem. Soc., Dalton Trans.
Journal of the Chemical Society (London), Dalton Transactions (England)
Supersedes in part J. Chem. Soc., A

J. Chem. Soc., Faraday Trans., I
Journal of the Chemical Society (London), Faraday Transactions, I (England)
Supersedes in part J. Chem. Soc., A and Trans. Faraday Soc.

J. Chem. Soc., Faraday Trans., II
Journal of the Chemical Society (London), Faraday Transactions, II (England)
Supersedes in part J. Chem. Soc., A and Trans. Faraday Soc.

J. Chem. Soc., Perkin Trans., II
Journal of the Chemical Society (London), Perkin Transactions, II (England)
Supersedes J. Chem. Soc., B

J. Chem. Thermodyn.
Journal of Chemical Thermodynamics, The (England - U.S.)

J. Chim. Phys.
Journal de Chimie Physique et de Physico-Chimie Biologique (France)

J. Chin. Chem. Soc. (Taiwan)
Journal of the Chinese Chemical Society (Taiwan) (China)

J. Chromatogr.
Journal of Chromatography (Netherlands)
Absorbed Chromatogr. Rev.

J. Chromatogr. Sci.
Journal of Chromatographic Science (U.S.)
Supersedes Journal of Gas Chromatography

J. Clin. Endocrinol. Metab.
Journal of Clinical Endocrinology and Metabolism, The (U.S.)

J. Clin. Invest.
Journal of Clinical Investigation, The (U.S.)

J. Colloid Interface Sci.
Journal of Colloid and Interface Science (Formerly Journal of Colloid Science) (U.S.)

J. Comb. Theory
Journal of Combinatorial Theory (U.S. - England)

J. Compos. Mater.
Journal of Composite Materials (U.S.)

J. Comp. Physiol. Psychol.
Journal of Comparative and Physiological Psychology (U.S.)

J. Comput. Phys.
Journal of Computational Physics (U.S.)

J. Coord. Chem.
Journal of Coordination Chemistry (England)

J. Cryst. Growth
Journal of Crystal Growth (Netherlands)

J. Cryst. Mol. Struct.
Journal of Crystal and Molecular Structure (England)

J. Dairy Sci.
Journal of Dairy Science (U.S.)

J. Econ. Entomol.
Journal of Economic Entomology (U.S.)

J. Electroanal. Chem.
Journal of Electroanalytical Chemistry (Netherlands)
Superseded by J. Electroanal. Chem. Interfacial Electrochem.

J. Electrochem. Soc.
Journal of the Electrochemical Society (U.S.)

J. Electron Spectros. Relat. Phenomena
Journal of Electron Spectroscopy and Related Phenomena (Netherlands)

J. Embryol. Exp. Morphol.
Journal of Embryology and Experimental Morphology (England)

Jenna Mech. Opt.
Jenna Mechanika a Optika (Czechoslovakia)

Jena Rev.
Jena Review (East Germany)

J. Eng. Math.
Journal of Engineering Mathematics (Netherlands)

J. Eng. Power
Journal of Engineering for Power, Transactions of the ASME (American Society of Mechanical Engineers), Series A (U.S.)

J. Environ. Qual.
Journal of Environmental Quality (U.S.)

J. Environ. Sci.
Journal of Environmental Sciences (U. S.)

J. Environ. Syst.
Journal of Environmental Systems (U.S.)

JETP Lett. (USSR) (Engl. Transl.)
JETP Letters (USSR) (English Translation of Pis'ma v Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki) (U.S.)

J. Exp. Mar. Biol. Ecol.
Journal of Experimental Marine Biology and Ecology (Netherlands)

J. Fish. Res. Board Can.
Journal of the Fisheries Research Board of Canada (Canada)

J. Fluid Mech.
Journal of Fluid Mechanics (England)

J. Food Sci.
Journal of Food Science (U.S.)

J. Food Sci. Technol. (India)
Journal of Food Science and Technology (India)

J. Forensic Sci.
Journal of Forensic Sciences (U.S.)

J. Franklin Inst.
Journal of the Franklin Institute (U.S.)

J. Gen. Chem. USSR (Engl. Transl.)
Journal of General Chemistry of the USSR (English Translation of Zhurnal Obshchei Khimii) (U.S.)

J. Gen. Virol.
Journal of General Virology (England)

J. Geochem. Explor.
Journal of Geochemical Exploration (Netherlands)

J. Geol. Soc. Aust.
Journal of the Geological Society of Australia (Australia)

J. Geol. Soc. India
Journal of the Geological Society of India (India)

J. Geomagnet. Geoelec.
Journal of Geomagnetism and Geoelectricity (Japan)

J. Geophys. Res.
Journal of Geophysical Research (U.S.)

J. Gerontol.
Journal of Gerontology (U.S.)

J. Heat Transfer
Journal of Heat Transfer, Transactions of the ASME (American Society of Mechanical Engineers), Series C (U.S.)

J. Hydraul. Div., Amer. Soc. Civil Eng.
Journal of the Hydraulics Division, American Society of Civil Engineers (U.S.)

J. Hydrol.
Journal of Hydrology (Netherlands)

Jibi Inko-ka
Jibi Inko-ka (Otolaryngology) (Japan)

Jibi To Rinsho
Jibi To Rinsho (Otologia Fukuoka) (Japan)

J. Immunol.
Journal of Immunology (U.S.)

J. Immunol. Methods
Journal of Immunological Methods (Netherlands)

J. Indian Bot. Soc.
Journal of the Indian Botanical Society (India)

J. Indian Chem. Soc.
Journal of the Indian Chemical Society (India)

J. Infect. Dis.
Journal of Infectious Diseases, The (U.S.)

J. Ing.
Journal des Ingenieurs (Belgium)

J. Inorg. Nucl. Chem.
Journal of Inorganic and Nuclear Chemistry (England)

J. Inst. Eng. (India)
Journal of the Institution of Engineers (India) (India)

J. Inst. Eng. (India), Elec. Eng. Div.
Journal of the Institution of Engineers (India), Electrical Engineering Division (India)

J. Inst. Eng. (India), Mech. Eng. Div.
Journal of the Institution of Engineers (India), Mechanical Engineering Division (India)

J. Inst. Eng. (India), Public Health Eng. Div.
Journal of the Institution of Engineers (India), Public Health Engineering Division (India)

J. Inst. Fuel
Journal of the Institute of Fuel (England)

J. Inst. Metals
Journal of the Institute of Metals with Bulletin and Metallurgical Abstracts (England)

J. Inst. Nucl. Eng.
Journal of the Institution of Nuclear Engineers (England)
Supersedes Nuclear Energy

J. Inst. Telecommun. Eng.
Journal of the Institution of Telecommunication Engineers (India)

J. Invest. Dermatol.
Journal of Investigative Dermatology, The (U.S.)

J. Irish Med. Ass.
Journal of the Irish Medical Association (Ireland)

J. Jap. Inst. Metals
Journal of the Japan Institute of Metals (Nippon Kinzoku Gakkaishi) (Japan)

J. Jap. Soc. Appl. Phys., Suppl.
Journal of the Japan Society of Applied Physics, Supplement (Japan)

J. Korean Inst. Elec. Eng.
Journal of the Korean Institute of Electrical Engineers, The (Daehan Jeonkihakhoe-ji) (South Korea)

J. Korean Inst. Metals
Journal of the Korean Institute of Metals (South Korea)

J. Korean Nucl. Soc.
Journal of the Korean Nuclear Society (South Korea)

J. Lab. Clin. Med.
Journal of Laboratory and Clinical Medicine, The (U.S.)

J. Label. Compounds
Journal of Labelled Compounds (Belgium)

J. Less-Common Metals
Journal of the Less-Common Metals (Switzerland)

J. Low Temp. Phys.
Journal of Low Temperature Physics (U.S.)

J. Lumin.
Journal of Luminescence (Netherlands)

J. Macromol. Sci., Part B
Journal of Macromolecular Science, Part B, Physics (U.S.)

J. Magn. Resonance
Journal of Magnetic Resonance (England)

J. Mass Spectrom. Ion Phys.
Journal of Mass Spectrometry and Ion Physics (Netherlands)

J. Mater. Sci.
Journal of Materials Science (England)

J. Math. Anal. Appl.
Journal of Mathematical Analysis and Applications (U.S.)

J. Math. Phys. (N.Y.)
Journal of Mathematical Physics (New York) (U.S.)

J. Math. Phys. Sci.
Journal of Mathematical and Physical Science (India)

J. Maxillofac. Surg.
Journal of Maxillofacial Surgery (West Germany)

J. Med. Ass. State Ala.
Journal of the Medical Association of the State of Alabama, The (U.S.)

J. Med. (Basel)
Journal of Medicine (Basel) (Switzerland)
Supersedes Medicina Experimentalis

J. Med. Chem.
Journal of Medicinal Chemistry (U.S.)

J. Med. Genet.
Journal of Medical Genetics (U. S.)

J. Metals
Journal of Metals (U.S.)

J. Meteorol.
Journal of Meteorology, The (U.S.)

J. Meteorol. Soc. Jap.
Journal of the Meteorological Society of Japan (Japan)

J. Microscop.
Journal de Microscopie (France)

J. Mines, Metals Fuels
Journal of Mines, Metals and Fuels (India)

J. Miss. State Med. Ass.
Journal of the Mississippi State Medical Association (U.S.)

J. Mol. Biol.
Journal of Molecular Biology (England)

J. Mol. Cell. Cardiol.
Journal of Molecular and Cellular Cardiology (U.S.)

J. Mol. Spectrosc.
Journal of Molecular Spectroscopy (U.S.)

J. Mol. Struct.
Journal of Molecular Structure (Netherlands)

J. Nat. Cancer Inst.
Journal of the National Cancer Institute (U.S.)

J. Natur. Sci. Math.
Journal of Natural Sciences and Mathematics (Pakistan)

J. Neural Transm.
Journal of Neural Transmission (Austria)

J. Neuropathol. Exp. Neurol.
Journal of Neuropathology and Experimental Neurology, The (U.S.)

J. Non-Cryst. Solids
Journal of Non-Crystalline Solids (Netherlands)

J. Nucl. Biol. Med.
Journal of Nuclear Biology and Medicine (Supersedes in Part Minerva Nucleare) (Italy)

J. Nucl. Energy
Journal of Nuclear Energy (Formerly Journal of Nuclear Energy, Parts A and B, Reactor Science and Technology) (England)
Superseded by Ann. Nucl. Sci. Eng.

J. Nucl. Mater.
Journal of Nuclear Materials (Journal des Materiaux Nucleaires) (Netherlands)

J. Nucl. Med.
Journal of Nuclear Medicine (U.S.)

J. Nucl. Sci. Technol. (Tokyo)
Journal of Nuclear Science and Technology (Tokyo) (Japan)

J. Nutr. Sci. Vitaminol.
Journal of Nutritional Science and Vitaminology (Japan) Supersedes J. Vitaminol. (Kyoto)

J. Obstet. Gynaecol. Brit. Commonwealth
Journal of Obstetrics and Gynaecology of The British Commonwealth (England)

J. Obstet. Gynaecol. India
Journal of Obstetrics and Gynaecology of India (India)

J. Occup. Med.
Journal of Occupational Medicine (U.S.)

Joensuun Korkeakoulun Julkaisuja, Ser. B
Joensuun Korkeakoulun Julkaisuja, Sarja B (Finland)

Johns Hopkins Med. J.
Johns Hopkins Medical Journal (U.S.)

J. Opt. Soc. Amer.
Journal of the Optical Society of America (U.S.)

J. Oral Pathol.
Journal of Oral Pathology (Denmark)

J. Org. Chem.
Journal of Organic Chemistry, The (U.S.)

J. Oslo City Hosp.
Journal of the Oslo City Hospitals (Norway)

J. Parasitol.
Journal of Parasitology, The (U.S.)

J. Pathol.
Journal of Pathology (Formerly Journal of Pathology and Bacteriology, The) (Scotland)
Ceased publication

J. Periodontal Res.
Journal of Periodontal Research (Denmark)

J. Petrol. Technol.
Journal of Petroleum Technology (U.S.)

J. Pharm. Pharmacol., Suppl.
Journal of Pharmacy and Pharmacology, Supplement (England)

J. Pharm. Sci.
Journal of Pharmaceutical Sciences (U.S.)

J. Phys. (Paris)
Journal de Physique (Paris) (Formerly le Journal de Physique et le Radium) (France)

J. Phys. (Paris), Colloq.
Journal de Physique (Paris), Colloque (France)

J. Phys., A (London)
Journal of Physics, A (London). Proceedings of the Physical Society (General) (Supersedes in Part Proceedings of the Physical Society (London)) (England)

J. Phys., B (London)
Journal of Physics, B (London). Proceedings of the Physical Society (Atomic and Molecular Physics) (Supersedes in Part Proceedings of the Physical Society (London)) (England)

J. Phys., C (London)
Journal of Physics, C (London) Proceedings of the Physical Society (Solid State Physics) (Supersedes in Part Proceedings of the Physical Society (London)) (England)

J. Phys., D (London)
Journal of Physics, D (London) (Supersedes British Journal of Applied Physics) (England)

J. Phys., E (London)
Journal of Physics, E (Supersedes Journal of Scientific Instruments) (England)

J. Phys., F (London)
Journal of Physics, F (London). Metal Physics (England)

J. Phys. Chem.
Journal of Physical Chemistry, The (U.S.)

J. Phys. Chem. Ref. Data
Journal of Physical and Chemical Reference Data (U.S.)

J. Phys. Chem. Solids
Journal of Physics and Chemistry of Solids (Formerly Physics and Chemistry of Solids, The) (England)

J. Physiol. (Paris)
Journal de Physiologie (Paris) (France)
Discontinued; incorporated in parent journal

J. Phys. Oceanogr.
Journal of Physical Oceanography (U.S.)

J. Phys. Soc. Jap.
Journal of the Physical Society of Japan (Japan)

J. Phys. Soc. Jap., Suppl.
Journal of the Physical Society of Japan, Supplement (Japan)

J. Plasma Phys.
Journal of Plasma Physics (England)

J. Polymer Sci., Polym. Chem. Ed.
Journal of Polymer Science, Polymer Chemistry Edition (formerly Journal of Polymer Science, Part A-1. Polymer Chemistry) (U.S.)

J. Polym. Sci., Polym. Lett. Ed.
Journal of Polymer Science, Polymer Letters Edition (formerly Journal of Polymer Science, Part B. Polymer Letters) (U.S.)

J. Polym. Sci., Polym. Phys. Ed.
Journal of Polymer Science, Polymer Physics Edition (formerly Journal of Polymer Science, Part A-2. Polymer Physics) (U.S.)

J. Polym. Sci., Part C
Journal of Polymer Science, Part C Polymer Symposia (U.S.)

J. Polym. Sci., Part D
Journal of Polymer Science, Part D Macromolecular Reviews (U.S.)

J. Power Div., Amer. Soc. Civil Eng.
Journal of the Power Division, Proceedings of the American Society of Civil Engineers (U.S.)

J. Proc. Roy. Soc. N. S. W.
Journal and Proceedings of the Royal Society of New South Wales (Australia)

J. Quant. Spectrosc. Radiative Transfer
Journal of Quantitative Spectroscopy and Radiative Transfer (England)

J. Radiat. Res.
Journal of Radiation Research (Japan)

J. Radioanal. Chem.
Journal of Radioanalytical Chemistry (Switzerland-Hungary)

J. Radiol., Electrol., Med. Nucl.
Journal de Radiologie, d'Electrologie, et de Medicine Nucleaire (France)

J. Reprod. Fert.
Journal of Reproduction and Fertility (England)

J. Res. Nat. Bur. Stand., A
Journal of Research of the National Bureau of Standards, A (U.S.)

J. Res. U. S. Geol. Surv.
Journal of Research of the U.S. Geological Survey (U.S.)

J. Roy. Astron. Soc. Can.
Journal of the Royal Astronomical Society of Canada (Canada)

J. S. Afr. Chem. Inst.
Journal of the South African Chemical Institute (South Africa)

J. S. Afr. Inst. Mining Met.
Journal of the South African Institute of Mining and Metallurgy (South Africa)

J. Sanit. Eng. Div., Amer. Soc. Civil Eng.
Journal of the Sanitary Engineering Division, Proceedings of The American Society of Civil Engineers (U.S.)

J. Sci. Food Agr.
Journal of the Science of Food and Agriculture (England)

J. Sci. Ind. Res.
Journal of Scientific and Industrial Research (India)

J. Sediment. Petrol.
Journal of Sedimentary Petrology (U.S.)

J. Shivaji Univ.
Journal of Shivaji University (India)

J. Soc. Leather Trades Chem.
Journal of the Society of Leather Trades Chemists (England)

J. Solid State Chem.
Journal of Solid State Chemistry (U. S.)

J. Solution Chem.
Journal of Solution Chemistry (U.S.)

J. Spacecraft Rockets
Journal of Spacecraft and Rockets (U.S.)

J. Statist. Phys.
Journal of Statistical Physics (U.S. - England)

J. Struct. Chem. (USSR) (Engl. Transl.)
Journal of Structural Chemistry (USSR) (English Translation of Zhurnal Strukturnoi Khimii) (U.S.)

J. Surg. Oncol.
Journal of Surgical Oncology (U. S.)

J. Tenn. Dent. Ass.
Journal of the Tennessee Dental Association (U.S.)

J. Test. Eval.
Journal of Testing and Evaluation (U.S.)
Supersedes J. Mater.

J. Text. Inst.
Journal of the Textile Institute (England)

J. Theor. Biol.
Journal of Theoretical Biology (England)

J. Trauma
Journal of Trauma (U. S.)

J. Univ. Bombay
Journal of the University of Bombay (India)

J. Univ. Poona
Journal of the University of Poona (India)

J. Urol. Nephrol.
Journal d'Urologie et de Nephrologie (France)

J. Vac. Sci. Technol.
Journal of Vacuum Science and Technology, The (U.S.)

J. Virol.
Journal of Virology (U.S.)

J. Water Pollut. Contr. Fed.
Journal of the Water Pollution Control Federation (Formerly Sewage and Industrial Wastes) (U.S.)

J. Wildlife Dis.
Journal of Wildlife Diseases (U.S.)

K

Kagaku (Kyoto)
Kagaku (Kyoto) (Chemistry) (Japan)

Kagaku (Tokyo)
Kagaku (Tokyo) (Science) (Japan)

Kagaku Kogyo
Kagaku Kogyo (Chemical Industry) (Japan)

Kagaku No Ryoiki
Kagaku No Ryoiki (Journal of Japanese Chemistry) (Japan)

Kagoshima Daigaku Igaku Zasshi
Kagoshima Daigaku Igaku Zasshi (Medical Journal of Kagoshima University) (Japan)

Kaku Igaku
Kaku Igaku (Nippon Kaku Igakkai Kikanshi) (Japanese Journal of Nuclear Medicine) (Japan)

Kakuriken Kenkyu Hokoku
Kakuriken Kenkyu Hokoku (Research Report of the Laboratory of Nuclear Science, Tohoku University) (Japan)

Kanazawa Daigaku Kogakubu Kiyo
Kanazawa Daigaku Kogakubu Kiyo (Memoirs of the Faculty of Technology, Kanazawa University) (Japan)

Kanazawa Irigaku Sosho
Kanazawa Irigaku Sosho (Journal of Radiology and Physical Therapy, University of Kanazawa, The) (Japan)

Kanko Shikiso
Kanko Shikiso (Medical Researches for Photosensitizing Dyes) (Japan)

Kansai Ika Daigaku Zasshi
Kansai Ika Daigaku Zasshi (The Journal of the Kansai Medical School) (Japan)

Kanzo
Kanzo (Acta Hepatologica Japonica) (Japan)

Karyoku Genshiryoku Hatsuden
Karyoku Genshiryoku Hatsuden (Thermal and Nuclear Power) (Japan)
Supersedes Karyoku Hatsuden

Karyoku Hatsuden
Karyoku Hatsuden (The Thermal Power) (Japan)
Continued as Karyoku Genshiryoku Hatsuden

Kauchuk Rezina
Kauchuk i Rezina (U.S.S.R.)

Kaut. Gummi Kunstst.
Kautschuk und Gummi Kunststoffe (West Germany)

Keikinzoku Yosetsu
Keikinzoku Yosetsu (Japan Light Metal Welding) (Japan)

Keio Igaku
Keio Igaku (Journal of the Keio Medical Society) (Japan)

Keisoku To Seigyo
Keisoku To Seigyo (Journal of the Society of Instrument and Control Engineers) (Japan)

Kenchiku Kenkyusho Nenpo
Kenchiku Kenkyusho Nenpo (Japan)

Kenritsu Gan Senta Niigata Byoin Ishi
Kenritsu Gan Senta Niigata Byoin Ishi (Journal of Cancer Center, Niigata Hospital) (Japan)

Kernenergie
Kernenergie (East Germany)

Kerntechnik
Kerntechnik Vereinigt mit Atompraxis. The Journal for Nuclear Engineers and Scientists (West Germany)

Ketsueki To Myakkan
Ketsueki To Myakkan (Blood and Vessel) (Japan)

KFK Nachr.
KFK (Kernforschungszentrum Karlsruhe) Nachrichten (West Germany)

Khidrol. Meteorol.
Khidrologiya i Meteorologiya (Bulgaria)

Khim. Drev.
Khimiya Drevesiny (Latvian S.S.R.)

Khim.-Farm. Zh.
Khimiko-Farmatsevticheskii Zhurnal (U.S.S.R.)

Khim. Ind. (Sofia)
Khimiya i Industriya (Sofia) (Bulgaria)

Khim. Tverd. Topl.
Khimiya Tverdogo Topliva (U.S.S.R.)

Khranit. Prom.
Khranitelna Promishlenost (Bulgaria)

Kikai No Kenkyu
Kikai No Kenkyu (Science of Machine) (Japan)

Kinet. Catal. (USSR) (Engl. Transl.)
Kinetics and Catalysis (USSR) (English Translation of Kinetika i Kataliz) (U.S.)

Kinet. Katal.
Kinetika i Kataliz (U.S.S.R.)
Issued in English Translation as Kinetics and Catalysis (USSR)

Kinki Daigaku Genshiryoku Kenkyusho Nenpo
Kinki Daigaku Genshiryoku Kenkyusho Nenpo (Annual Reports of Kinki University Atomic Energy Research Institute) (Japan)

Kinzoku Hyomen Gijutsu
Kinzoku Hyomen Gijutsu (The Journal of the Metal Finishing Society of Japan) (Japan)

Kinzoku Zairyo
Kinzoku Zairyo (Metals in Engineering) (Japan)

Kiserl. Orvostud.
Kiserletes Orvostudomany (Hungary)

Kiso To Rinsho
Kiso To Rinsho (Clinical Report, The) (Japan)

Kitakanto Igaku
Kitakanto Igaku (Kitakanto Medical Journal) (Japan)

Kjemi
Kjemi (Formerly Tidsskrift for Kjemi, Bergvesen og Metallurgi) (Norway)

Klima Kaelteing.
Klima und Kaelteingenieur (West Germany)
Supersedes Kaeltetech.-Klim

Klin. Monatsbl. Augenheilk.
Klinische Monatsblaetter fuer Augenheilkunde und fuer Augenaerztliche Fortbildung (West Germany)

Koatsu Gasu
Koatsu Gasu (Journal of the Inst. for Safety of High Pressure Gas Engineering) (Japan)

Kobalt
Kobalt (West Germany)

Kobe Shosen Daigaku Kiyo. Dai-2-rui. Kokai, Kikan, Rigaku-hen
Kobe Shosen Daigaku Kiyo. Dai-2-rui. Kokai, Kikan, Rigaku-hen (Review of Kobe University of Mercantile Marine. Part II. Navigation, Marine Engineering, and Scientific Section) (Japan)

Kobunshi Kagaku
Kobunshi Kagaku (Chemistry of High Polymers) (Japan)

Kobunshi Ronbunshu
Kobunshi Ronbunshu (Collected Papers on High Polymers) (Japan)
Supersedes Kobunshi Kagaku

Kogai Shigen Kenkyusho Hokoku
Kogai Shigen Kenkyusho Hokoku (Report of the National Research Institute for Pollution and Resources) (Japan)
Supersedes Shigen Gijutsu Snikenjo Hokoku

Kogyo Rea Metaru
Kogyo Rea Metaru (The Industrial Rare Metals) (Japan)

Kogyo Zairyo
Kogyo Zairyo (Engineering Materials) (Japan)

K'o Hsueh Shih Yen
K'o Hsueh Shih Yen (Science Experiments) (China)

K'o Hsueh T'ung Pao
K'o Hsueh T'ung Pao (Scientia) (China)

Kokyu To Junkan
Kokyu To Junkan (Respiration and Circulation) (Japan)

Kolloid-Z. Z. Polym.
Kolloid-Zeitschrift und Zeitschrift fuer Polymere, zur Zeit Vereinigt mit den Kolloid-Beiheften (Formerly Kolloid-Zeitschrift, -Zeitschrift fuer Polymere) (West Germany)

Konkurito Janaru
Konkurito Janaru (Concrete Journal) (Japan)

Konstr., Elem., Method.
Konstruktion, Elemente, Methoden (West Germany)

Konstr. Ing. Ber.
Konstruktiver Ingenieurbau Berichte (West Germany)

Konstr. Masch.-, App.- Geraetebau
Konstruktion im Maschinen-, Apparate- und Geraetebau (West Germany)

Korean J. Anim. Sci.
Korean Journal of Animal Science (Dongmulhakhoe-ji) (South Korea)

Korean J. Hort. Sci.
Korean Journal of Horticultural Science (Hankuk Wonyehakhow-ji) (South Korea)

Korean J. Microbiol.
Korean Journal of Microbiology (South Korea)

Kosm. Biol. Aviakosmicheskaya Med.
Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina
Supersedes Kosm. Biol. Med.

Kosm. Biol. Med.
Kosmicheskaya Biologiya i Meditsina (U.S.S.R.)
Issued in English Translation as Space biology and Medicine (USSR)

Kosm. Issled. Ukr.
Kosmicheskie Issledovaniya na Ukraine (Ukrainian S.S.R.)

Kosm. Luchi
Kosmicheskie Luchi (U.S.S.R.)

Kotsu Igaku
Kotsu Igaku (The Journal of Transportation Medicine) (Japan)

Kovove Mater.
Kovove Materialy (Czechoslovakia)

Kratk. Soobshch. Fiz.
Kratkie Soobshcheniya po Fizike (U.S.S.R.)

Kriog. Vak. Tekh.
Kriogennaya i Vakuumnaya Tekhnika (Ukrainian S.S.R.)

Krist. Tech.
Kristall und Technik (East Germany)

Kumamoto Daigaku Kogakubu Kenkyu Hokoku
Kumamoto Daigaku Kogakubu Kenkyu Hokoku (Technical Reports of the Kumamoto University) (Japan)

Kumamoto Daigaku Kyoikugakubu Kiyo, Shizenkagaku
Kumamoto Daigaku Kyoikugakubu Kiyo, Shizenkagaku (Memoirs of the Facuity of Education, Kumamoto University, Natural Science) (Japan)

Kumamoto Igakkai Zasshi
Kumamoto Igakkai Zasshi (The Journal of the Kumamoto Medical Society) (Japan)

Kunststoffe
Kunststoffe. Organ der Deutschen Kunstoff-Fachverbaende (West Germany)

Kvantovaya Elektron. (Moscow)
Kvantovaya Elektronika (Moscow) (U.S.S.R.)
Issued in English translation as Sov. J. Quantum Electron.

KWU-Rep.
KWU-Report (Kraftwerk Union A.G.) (West Germany)

Kyosai Iho
Kyosai Iho (Medical Journal of Mutual Aid Association) (Japan)

Kyoto Furitsu Ika Daigaku Zasshi
Kyoto Furitsu Ika Daigaku Zasshi (Journal of Kyoto Prefectural Medical University) (Japan)

Kyushu Daigaku Kogaku Shuho
Kyushu Daigaku Kogaku Shuho (Technology Reports of the Kyushu University) (Japan)

Kyushu Shika Gakkai Zasshi
Kyushu Shika Gakkai Zasshi (The Journal of the Kyushu Dental Society) (Japan)

L

Lab. Anim.
Laboratory Animals (England)

Lab. Pract.
Laboratory Practice (England)

Laekartidningen
Laekartidningen (Sweden)
Supersedes Svenska Laekartidningen

Lakokrasoch. Mater. Ikh Primen.
Lakokrasochnye Materialy i Ikh Primenenie (U.S.S.R.)

Lancet
Lancet, The (England)

Latv. PSR Zinat. Akad. Vestis
Latvijas PSR Zinatnu Akademijas Vestis (Latvian S.S.R.)

Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.
Latvijas PSR Zinatnu Akademijas Vestis, Fizikas un Tehnisko Zinatnu Serija (Latvian S.S.R.)

Lavori Ist. Anat. Istol. Patol., Univ. Studi Perugia
Lavori dell'Istituto di Anatomia e Istologia Patologica della Universita Degli Studi di Perugia (Italy)

Lav. Umano
Lavoro Umano (Italy)

Lebensm.-Wiss. Technol.
Lebensmittel-Wissenschaft und Technologie (Switzerland)

Lect. Theor. Phys.
Lectures in Theoretical Physics (U. S.)

Lek. Obz.
Lekarsky Obzor (Czechoslovakia)

Lek. Zpr.
Lekarske Zpravy (Czechoslovakia)

Letop. Khig. Epidemiol. Inst.
Letopisi na Khigienno Epidemiologichnite Instituti (Bulgaria)

Lett. Nuovo Cim.
Lettere al Nuovo Cimento (Italy)

Libri Oncol.
Libri Oncologici (Yugoslavia)

Liet. Fiz. Rinkinys
Lietuvos Fizikos Rinkinys (Lithuanian S.S.R.)

Liet. TSR Mokslu Akad. Darbai, Ser. B
Lietuvos TSR Mokslu Akademijos Darbai, Serija B (Lithuanian S.S.R.)

Life Sci.
Life Sciences (U.S.)
Divided into Parts I and II; reverted to former title with Vol. 13, No. 1, July 1, 1973

Life Sci. Space Res.
Life Sciences and Space Research (Netherlands)

Limnol. Oceanogr.
Limnology and Oceanography (U.S.)

Lipids
Lipids (U.S.)

Liteinoe Proizvod.
Liteinoe Proizvodstvo (U.S.S.R.)

Litol. Polez. Iskop.
Litologiya i Poleznye Iskopaemye (U.S.S.R.)

M

Macromolecules
Macromolecules (U.S.)

Magn. Gidrodin.
Magnitnaya Gidrodinamika, Akademiya Nauk Latviiskoi SSR (Latvian S.S.R.)
Issued in English translation as Magnetohydrodynamics (USSR)

Magy. Alum.
Magyar Aluminium (Hungary)

Magy. Fiz. Foly.
Magyar Fizikai Folyoirat (Hungary)

Magy. Kem. Foly.
Magyar Kemiai Folyoirat (Hungary)

Magy. Kem. Lapja
Magyar Kemikusok Lapja (Hungary)

Magy. Radiol.
Magyar Radiologia (Hungary)

Magy. Tud. Akad. Muszaki Fiz. Kutato Intez. Kozlem.
Magyar Tudomanyos Akademia Muszaki Fizikai Kutato Intezetenek Kozlemenyei (Hungary)

Maintenance
Maintenance (France)

Manage. Today
Management Today (England)

Manitoba Entomol.
Manitoba Entomologist (Canada)

Mar. Biol.
Marine Biology (Constitutes Proceedings of the International Interdisciplinary Conference on Marine Biolgy) (West Germany - U.S.)

Mater. Eval.
Materials Evaluation (Formerly Nondestructive Testing) (U.S.)

Materialpruefung
Materialpruefung (West Germany)

Mater. Nouv. Tech. Mond.
Materiels Nouveaux et Techniques Mondiales (France)

Mater. Protect. Performance
Materials Protection and Performance (U. S.)
Superseded by Mater. Perfomance

Mater. Res. Bull.
Materials Research Bulletin (U.S.)

Mater. Sci. Eng.
Materials Science and Engineering (Netherlands)

Mater. Tech.
Materiaux et Techniques (France)

Math. Biosci.
Mathematical Biosciences (U.S.)

Math. Comput.
Mathematics of Computation (U.S.)

Mayakkangaku
Mayakkangaku (The Journal of Japanese College of Angiology) (Japan)

Meas. Contr.
Measurement and Control (Supersedes Transaction of the Society of Instrument Technology) (England)

Meas. Tech. (USSR) (Engl. Transl.)
Measurement Techniques (USSR) (English Translation of Izmeritelnaya Tekhnika) (U.S.)

Mecan. Mater. Elec.
Mecanique Materiaux Electricite (France)
Supersedes Mecanique Electricite

Mech. Ageing Develop.
Mechanisms of Ageing and Development (Switzerland)

Mech. Eng.
Mechanical Engineering (U.S.)

Med. Clin. N. Amer.
Medical Clinics of North America, The (U.S.)

Med. Dosw. Mikrobiol.
Medycyna Doswiadczalna i Mikrobiologia (Poland)

Med. Instrum. (Arlington)
Medical Instrumentation (Arlington) (U.S.)

Med. J. Aust.
Medical Journal of Australia, The (Australia)

Med. J. Hiroshima Univ.
Medical Journal of Hiroshima University (Hiroshima Daigaku Igaku Zasshi) (Japan)

Med. Klin. (Munich)
Medizinische Klinik (Munich) (West Germany)

Med. Lavoro
Medicina del Lavoro, La (Italy)

Med. Nucl. -Radiobiol. Lat., Suppl.
Medicina Nucleare - Radiobiologica Latina, Suppl. (Italy)
Ceased publication

Med. Phys.
Medical Physics (U.S.)

Med. Pracy
Medycyna Pracy (Poland)

Med. Radiol.
Meditsinskaya Radiologiya (U.S.S.R.)
Issued in English translation as Med. Radiol. (USSR)

Med. Sci. Sports
Medicine and Science in Sports (U.S.)

Med. Tekh.
Meditsinskaya Tekhnika (U.S.S.R.)

Med. Wet. (Poland)
Medycyna Weterynaryjna (Poland)

Meerestechnik
Meerestechnik/Marine Technology (West Germany)

Mekh. Polim.
Mekhanika Polimerov (Latvian S.S.R.)

Mekh. Tverd. Tela
Mekhanika Tverdogo Tela (Ukrainian S.S.R.)

Mem. Accad. Sci. Torino, Cl. Sci. Fis., Mat. Natur.
Memoire della Accademia delle Scienze di Torino, Classe di Scienze Fisicne, Matematiche e Naturali (Italy)

Mem. Fac. Eng., Kyoto Univ.
Memoirs of the Faculty of Engineering, Kyoto University (Japan)

Mem. Fac. Eng., Kyushu Univ.
Memoirs of the Faculty of Engineering, Kyusnu University (Japan)

Mem. Fac. Sci., Kyoto Univ., Ser. Phys., Astrophys., Geophys., Chem.
Memoirs of the Faculty of Science, Kyoto University, Series of Physics, Astrophysics, Geophysics, and Chemistry (Formerly Memoirs of the College of Science, University of Kyoto. Series A) (Japan)

Mem. Fac. Sci., Kyushu Univ., Ser. B
Memoirs of the Faculty of Science, Kyushu University, Series B. Physics (Japan)

Mem. Sci. Rev. Met.
Memoires Scientifiques de la Revue de Metallurgie, Les (Formerly a Part of Revue de Metallurgie) (France)

Mem. Soc. Roy. Sci. Liege
Memoires de la Societe Royale des Sciences de Liege (Belgium)

Mes., Regul., Automat.
Mesures, Regulation, Automatisme (France)

Messtechnik
Messtechnik. Zeitschrift fuer Instrumentenkunde (Supersedes Zeitschrift fuer Instrumentenkunde) (West Germany)

Messwerte
Messwerte (West Germany)

Metal Bull. Mon.
Metal Bulletin Monthly (England)

Metall
Metall. Internazionale Zeitschrift fuer Technik und Wirtschaft (West Germany)

Metalloberflaeche
Metalloberflaeche (West Germany)
Changed to Metalloberflaeche-Angew. Elektrochem.

Metallofizika
Metallofizika (Ukrainian S.S.R.)

Metallography
Metallography. An International Journal (U.S.)

Metalloved. Term. Obrab. Metal.
Metallovedenie i Termicheskaya Obrabotka Metallov (Formerly Metallovedenie i Obrabotka Metallov) (U.S.S.R.)
For English Translation see Metal Science and Heat Treatment (USSR)

Metal Progr.
Metal Progress (U.S.)

Metal Sci. Heat Treat. (USSR) (Engl. Transl.)
Metal Science and Heat Treatment (USSR) (English Translation of Metallovedenie i Termicheskaya Obrabotka Metallov) (U.S.)

Metal Sci. J.
Metal Science Journal (England)

Metals Eng. Quart.
Metals Engineering Quarterly (U.S.)

Metals Miner. Rev.
Metals and Minerals Review (India)

Metalurgia (Sao Paulo)
Metalurgia (Sao Paulo) (Brazil)

Metaux (Corros.-Ind.)
Metaux (Corrosion-Industrie) (France)

Meteoritics
Meteoritics (U. S.)

Meteoritika
Meteoritika (U.S.S.R.)

Meteorol. Gidrol.
Meteorologiya i Gidrologiya (U.S.S.R.)

Meteorologie
Meteorologie, La (France)

Meteorol. Rundsch.
Meteorologische Rundschau (West Germany)

Meteorol. Zpr.
Meteorologicke Zpravy (Czechoslovakia)

Methods Carbohyd. Chem.
Methods in Carbohydrate Chemistry (U.S.)

Methods Cell. Biol.
Methods in Cell Biology (U.S.)

Met. Ital.
Metallurgia Italiana (Includes the Section Atti Notizie, Associazione Italiana de Metallurgia) (Italy)

Met. Rep. CRM (Cent. Rech. Met., Brussels)
Metallurgical Reports CRM (Centre de Recherches Metallurgiques, Brussels) (Belgium)
Supersedes CNRM (Cent. Nat. Rech. Met.) Met. Rep.

Metrol. Insp.
Metrology and Inspection (England)

Metrologia
Metrologia (West Germany)

Met. Trans.
Metallurgical Transactions (formerly Transactions of the Metallurgical Society of AIME and Transactions Quarterly of American Society for Metals) (U. S.)

Microbios
Microbios (U. S.)

Microchem. J.
Microchemical Journal (U.S.)

Micron
Micron (England)

Mikrobiologiya
Mikrobiologiya (U.S.S.R.)
For English Translation see Microbiology (USSR)

Mikrobiol. Zh.
Mikrobiologicnenyi Zhurnal (Ukrainian S.S.R.)

Mikrochim. Acta
Mikrochimica Acta (Formerly Mikrochimica et Ichoanalytica Acta) (Austria)

Milchwissenschaft
Milchwissenschaft (West Germany)

Minami Osaka Byoin Igaku Zasshi
Minami Osaka Byoin Igaku Zasshi (Medical Journal of Minami Osaka Hospital) (Japan)

Mineral. Mag.
Mineralogical Magazine and Journal of the Mineralogical Society (England)

Miner. Sci. Eng.
Minerals Science and Engineering (South Africa)

Minerva Fisiconucl.
Minerva Fisiconucleare. Giornale di Fisica Sanitaria e Protezione Contro le Radiazioni (Italy)
Changed to G. Fis. Sanit. Prot. Radiaz.

Minerva Ginecol.
Minerva Ginecologica (Italy)

Minerva Med.
Minerva Medica (Italy)

Minerva Pediat.
Minerva Pediatrica (Italy)

Mining Congr. J.
Mining Congress Journal (U.S.)

Mining Eng. (N.Y.)
Mining Engineering (New York) (U.S.)

Minn. Med.
Minnesota Medicine (U.S.)

Mitsubishi Denki Giho
Mitsubisni Denki Giho (Mitsubishi Denki Technical Review) (Japan)

Mitt. Astron. Ges.
Mitteilungen der Astronomischen Gesellschaft (West Germany)

Mitteilungsbl. GDCh (Ges. Deut. Chem.)-Fachgruppe Lebensmittelchem. Gerichtl. Chem.
Mitteilungsblatt der GDCh (Gesellschaft Deutscher Chemiker)-

Fachgruppe Lebensmittelchemie und Gerichtliche Chemie (West Germany)

Mitt. Mitglieder Tech. Ueberwach.-Vereins Bayern
Mitteilungen fuer die Mitglieder des Technischen Ueberwachungs-Vereins Bayern (West Germany)

Miyazaki Daigaku Kogakubu Kenkyu Hokoku
Miyazaki Daigaku Kogakubu Kenkyu Hokoku (Bulletin of the Faculty of Engineering, Miyazaki University) (Japan)

Mizu Shori Gijutsu
Mizu Shori Gijutsu (Water Purification and Liquid Wastes Treatment) (Japan)

Mod. Kemi
Modern Kemi (Sweden)

Mod. Power Eng.
Modern Power and Engineering (Canada)

Mokuzai Gakkaishi
Mokuzai Gakkaishi (Journal of the Japan Wood Research Society) (Japan)

Mol. Cryst. Liquid Cryst.
Molecular Crystals and Liquid Crystals (formerly Molecular Crystals) (England)

Mol. Gen. Genet.
Molecular and General Genetics (MGG) (Continuation of Zeitschrift fuer Vererbungslehre) (West Germany)

Mol. Phys.
Molecular Physics (England)

Molybdaen-Dienst
Molybdaen-Dienst (West Germany)

Monatsh. Chem.
Monatshefte fuer Chemie (Austria)

Mon. Notic. Roy. Astron. Soc.
Monthly Notices of the Royal Astronomical Society (England)

Monokrist. Tekh.
Monokristally i Tekhnika (Ukrainian S.S.R.)

MPG (Max-Planck-Ges.) Presseinform.
MPG (Max-Planck-Gesellschaft) Presseinformation (West Germany)

Muehle Mischfutterteca.
Muehle und Mischfuttertechnik (West Germany)
Supersedes Muehle

Muenchen. Med. Wochenschr.
Muenchener Medizinische Wochenschrift (West Germany)

Muroran Kogyo Daigaku Kenkyu Hokoku
Muroran Kogyo Daigaku Kenkyu Hokoku (Memoirs of the Muroran University of Engineering) (Japan)

Musz. Tud.
Muszaki Tudomany (Formerly Magyar Tudomanyos Akademia Muszaki Tudomanyok Osztalyanak Kozlemenyeia) (Hungary)

Mutat. Res.
Mutation Research (Netherlands)
Absorbed Newslett. Environ. Mutagen Soc.

Mycopathol. Mycol. Appl.
Mycopathologia et Mycologia Applicata (Netherlands)

Mykosen
Mykosen (West Germany)

N

Nachr. Chem. Tech.
Nachrichten aus Chemie und Technik (Supplement to Angew. Chem.) (West Germany)

Nagoya Daigaku Kankyo Igaku Kenkyusho Nempo
Nagoya Daigaku Kankyo Igaku Kenkyusho Nempo (Japan)
English Edition Issued as Annu. Rep. Res. Inst. Environ. Med., Nagoya Univ.

Nagoya Kogyo Gijutsu Shikensho Hokoku
Nagoya Kogyo Gijutsu Shikensho Hokoku (Reports of the Government Industrial Research Institute, Nagoya) (Japan)

Nagoya Shiritsu Daigaku Igakkai Zasshi
Nagoya Shiritsu Daigaku Igakkai Zasshi (The Journal of the Nagoya City University Medical Association) (Japan)

Naika Hokan
Naika Hokan (Japanese Archives of Internal Medicine) (Japan)

Narodno Zdravlje
Narodno Zdravlje (Yugoslavia)

Nat. Cancer Inst. Monogr.
National Cancer Institute Monograph (U.S.)

Nat. Tech. Rep. (Matsushita Elec. Ind. Co., Osaka)
National Technical Report (Matsushita Electric Industrial Co., Osaka) (Japan)

Natura (Plovdiv)
Natura (Plovdiv) (Bulgaria)

Nature (London)
Nature (London) (England)

Nature (London) New Biol.
Nature (London) New Biology (England)
Absorbed by Nature (London)

Nature (London) Phys. Sci.
Nature (London) Physical Science (England)
Absorbed by Nature (London)

Naturen
Naturen (Norway)

Naturwissenschaften
Naturwissenschaften, Die (West Germany)

Naturwiss. Rundsch.
Naturwissenschaftliche Rundschau (West Germany)

Nauch. Tr., Gos. Nauch.-Issled. Proekt. Inst. Redkometal. Prom.
Nauchnye Trudy, Gosudarstvennyi Nauchno-Issledovatel'skii i Proektnyi Institut Redkometallicheskoi Promyshlennosti (U.S.S.R.)

Nauch. Tr., Sib. Gos. Nauch.-Issled. Proekt. Inst. Tsvet. Met.
Nauchnye Trudy, Sibirskii Gosudarstvennyi Nauchno-Issledovatel'skii i Proektnyi Institut Tsvetnoi Metallurgii (U.S.S.R.)

Nauch. Tr., Tashkent. Gos. Univ.
Nauchnye Trudy, Tashkentskii Gosudarstvennyi Universitet imeni V. I. Lenina (U.S.S.R.)

Nav. Eng. J.
Naval Engineers Journal (U.S.)

Ned. Tijdschr. Tandheelk.
Nederlands Tijdschrift voor Tandheelkunde (Netherlands)

Neftepром. Delo
Neftepromyslovoe Delo (U.S.S.R.)

Neft. Gazov. Prom.
Neftyanaya i Gazovaya Promyshlennost (Ukrainian S.S.R.)

Nenryo Kyokai-shi
Nenryo Kyokai-shi (Journal of the Fuel Society of Japan) (Japan)

Neoplasma
Neoplasma (Czechoslovakia)

Nephron
Nephron (Switzerland)

Nervenarzt
Nervenarzt, Der (West Germany)

Neth. J. Sea Res.
Netherlands Journal of Sea Research (Netherlands)

Neue Juristische Wochunschr.
Neue Juristische Wochenschrift (West Germany)

Neue Tech.
Neue Technik (Switzerland)
Supersedes Neue Tech., A and B

Neurol. Neurochir. Pol.
Neurologia i Neurochirurgia Polska (Poland)

Neuropatol. Pol.
Neuropatologia Polska (Poland)

Neuroradiology
Neuroradiology (West Germany)

New Engl. J. Med.
New England Journal of Medicine, The (U.S.)

New Phys. (S. Korea)
New Physics (South Korea)

New Phytol.
New Phytologist, The (England)

New Sci.
New Scientist (England)
Merged with Science Journal to form New Scientist and Science Journal; changed back to New Scientist with Dec. 2, 1971 issue

Newslett. ENEA Comput. Programme Libr.
Newsletter of the ENEA Computer Programme Library (Italy)

Nichidai Igaku Zasshi
Nichidai Igaku Zasshi (Nihon University Medical Journal) (Japan)

Nichidoku Iho
Nichidoku Iho (Japan-Germany Medical Reports) (Japan)

Nihon Daigaku Seisan Kogakubu Hokoku
Nihon Daigaku Seisan Kogakubu Kokoku (Journal of the College of Industrial Technology, Nihon University) (Japan)

Niigata Igakkai Zasshi
Niigata Igakkai Zasshi (Niigata Medical Journal) (Japan)

Nippon Butsuri Gakkaishi
Nippon Butsuri Gakkaishi (Proceedings of the Physical Society of Japan) (Japan)

Nippon Chikusan Gakkai-Ho
Nippon Chikusan Gakkai-Ho (Japanese Journal of Zootechnical Science) (Japan)

Nippon Eiseigaku Zasshi
Nippon Eiseigaku Zasshi (Japanese Journal of Hygiene) (Japan)

Nippon Gan Chiryo Gakkai-Shi
Nippon Gan Chiryo Gakkai-Shi (Journal of Japan Society for Cancer Therapy, The) (Japan)

Nippon Genshiryoku Gakkaishi
Nippon Genshiryoku Gakkaishi (Journal of the Atomic Energy Society of Japan) (Japan)

Nippon Genshiryokusen Kaihatsu Jigyodan Nenpo
Nippon Genshiryokusen Kaihatsu Jigyodan Nenpo (Japan)

Nippon Hoshasen Gijutsu Gakkai Zasshi
Nippon Hoshasen Gijutsu Gakkai Zasshi (Japanese Journal of Radiological Technology) (Japan)

Nippon Igaku Hoshasen Gakkai Zasshi
Nippon Igaku Hoshasen Gakkai Zasshi (Nippon Acta Radiologica (Japan)

Nippon Iji Shimpo
Nippon Iji Shimpo (Japanese Medical Journal) (Japan)

Nippon Isnikai Zassni
Nippon Isnikai Zassni (The Journal of tne Japan Medical Association) (Japan)

Nippon Jibi Inkoka Gakkai Kaino
Nippon Jibi Inkoka Gakkai Kaiho (Journal of the Oto-Rhino-Laryngological Society of Japan) (Japan)

Nippon Kagaku Kaishi
Nippon Kagaku Kaishi (Journal of the Chemical Society of Japan, Chemistry and Industrial Chemistry) (Japan)
Supersedes Nippon Kagaku Zasshi and Kogyo Kagaku Zasshi

Nippon Kaisui Gakkaishi
Nippon Kaisui Gakkaishi (Bulletin of the Society of Sea Water Science, Japan) (Japan)

Nippon Ketsueki Gakkai Zasshi
Nippon Ketsueki Gakkai Zasshi (Acta Haematologica Japonica) (Japan)

Nippon Kikai Gakkai Ronbunshu
Nippon Kikai Gakkai Ronbunshu (Transactions of the Japanese Society of Mechanical Engineers) (Japan)

Nippon Kikai Gakkaishi
Nippon Kikai Gakkaishi (Journal of the Japan Society of Mechanical Engineers) (Japan)

Nippon Kinzoku Gakkai Kaiho
Nippon Kinzoku Gakkai Kaiho (Bulletin of the Japan Institute of Metals) (Japan)

Nippon Kogyo Kaishi
Nippon Kogyo Kaishi (Journal of the Mining and Metallurgical Institute of Japan) (Japan)

Nippon Koshu Eisei Zasshi
Nippon Koshu Eisei Zassni (Japanese Journal of Public Health) (Japan)

Nippon Kyobu Rinsho
Nippon Kyobu Rinsho (The Japanese Journal of Chest Diseases) (Japan)

Nippon Monaikei Gakkai Kaishi
Nippon Monaikei Gakkai Kaishi (Japan)

Nippon Naibumpi Gakkai Zassni
Nippon Naibumpi Gakkai Zassni (Folia Endocrinologica Japonica) (Japan)

Nippon Naika Gakkai Zasshi
Nippon Naika Gakkai Zasshi
(The Journal of Japanese Society of Internal Medicine)
(Japan)

Nippon Nogeikagaku Kaishi
Nippon Nogeikagaku Kaishi (Journal of the Agricultural Chemical Society of Japan) (Japan)

Nippon No Kagaku To Gijutsu
Nippon No Kagaku To Gijutsu (Science and Technology of Japan) (Japan)

Nippon Rinsho
Nippon Rinsho (Japanese Journal of Clinical Medicine) (Japan)

Nippon Saigai Igakkai Kaishi
Nippon Saigai Igakkai Kaishi (The Journal of Japan Accident Medical Association) (Japan)

Nippon Saikingaku Zassni
Nippon Saikingaku Zasshi (Japanese Journal of Bacteriology) (Japan)

Nippon Sanka Fujinka Gakkai Zasshi
Nippon Sanka Fujinka Gakkai Zasshi (Journal of Japanese Obstetrics and Gynecological Society) (Japan)

Nippon Seikei Geka Gakkai Zassni
Nippon Seikei Geka Gakkai Zasshi (Journal of Japanese Orthopaedic Association) (Japan)

Nippon Shika Ishikai Zasshi
Nippon Shika Ishikai Zasshi (Japan)

Nippon Shokubutsu Byori Gakkaiho
Nippon Shokubutsu Byori Gakkaiho (Annals of the Phytopathological Society of Japan) (Japan)

Nippon Shokuhin Kogyo Gakkaishi
Nippon Shokuhin Kogyo Gakkaishi (Journal of Food Science and Technology) (Japan)

Nippon Suisan Gakkaishi
Nippon Suisan Gakkaisni (Bulletin of the Japanese Society of Scientific Fisheries) (Japan)

Nippon Yuketsu Gakkai Zasshi
Nippon Yuketsu Gakkai Zasshi (Journal of the Japan Society of Blood Transfusion) (Japan)

NML (Nat. Met. Lab.) Tech. J. (Jamshedpur, India)
NML (National Metallurgical Laboratory) Technical Journal (Jamshedpur, India) (India)

Non-Destruct. Test. (Guildford, Engl.)
Non-Destructive Testing (Guildford, England) (England)

Nord. Hydrol.
Nordic Hydrology (Denmark)

Normalizace
Normalizace (Czechoslovakia)

Norsk Farm. Tidsskr.
Norsk Farmaceutisk Tidsskrift (Norway)

Notas Fis., Cent. Brasil. Pesqui. Fis.
Notas de Fisica, Centro Brasileiro de Pesquisas Fisicas (Brazil)

Notes Etud. Doc.
Notes et Etudes Documentaires (France)

No To Shinkei
No To Shinkei (Brain and Nerve) (Japan)

Nouv. Presse Med.
Nouvrelle Presse Medicale, La (France)
Supersedes Presse Medicale, La

Nouv. Rev. Fr. Hematol.
Nouvelle Revue Francaise d'Hematologie (France)

Nouv. Rev. Opt.
Nouvelle Revue d'Optique (France)
Supersedes Nouv. Rev. Opt. Appl.

Nowotwory
Nowotwory (Poland)

Nucl. Can.
Nuclear Canada/Canada Nucleaire (Canada)

Nucl. Data Sheets
Nuclear Data Sheets (formerly carried as Nuclear Data, Section B) (U.S.)

Nucl. Eng.
Nuclear Engineering Incorporating Nuclear Power (England)
Superseded by Nuclear Engineering International

Nucl. Eng. Des.
Nuclear Engineering and Design (Formerly Nuclear Structural Engineering) (Netherlands)

Nucl. Eng. Int.
Nuclear Engineering International Incorporating Nuclear Power (Formerly Nuclear Engineering) (England)

Nucleus (Calcutta)
Nucleus (Calcutta) (India)

Nucl. Fusion
Nuclear Fusion (Journal of Plasma Physics and Thermonuclear Fusion) (Austria)

Nucl. India
Nuclear India (India)

Nucl. Instrum. Methods
Nuclear Instruments and Methods (Formerly Nuclear Instruments) (Netherlands)

Nucl. Mater. Manage.
Nuclear Materials Management (U.S.)

Nucl.-Med.
Nuclear-Medizin (West Germany)

Nucl. Met., Met. Soc. AIME
Nuclear Metallurgy, Metallurgical Society of AIME (American Institute of Mining, Metallurgical and Petroleum Engineers) (U.S.)

Nucl. Phys., A
Nuclear Physics, A (Netherlands)

Nucl. Phys., B
Nuclear Physics, B (Netherlands)

Nucl. Safety
Nuclear Safety (A Bimonthly Technical Progress Review) (U.S.)

Nucl. Sci. Appl., Ser. B
Nuclear Science and Applications, Series B (Pakistan)

Nucl. Sci. Eng.
Nuclear Science and Engineering (U.S.)

Nucl. Sci. J. (Taiwan)
Nuclear Science Journal (Taiwan) (Ho Tsu K'o Hsueh) (China)

Nucl. Technol.
Nuclear Technology (U. S.)
Supersedes Nuclear Applications and Technology

Nuisances Environ.
Nuisances et Environnement (France)

Nukleon
Nukleon (Czechoslovakia)

Nukleonika
Nukleonika (Poland)

Nunt. Radiol.
Nuntius Radiologicus (Italy)
Ceased publication

Nuovi Ann. Ig. Microbiol.
Nuovi Annali d'Igiene e Microbiologia (Italy)

Nuovo Cim.
Nuovo Cimento, Il (Italy)
Superseded by Nuovo Cimento, Il, A and B

Nuovo Cim., A
Nuovo Cimento, Il, A (Italy)

Nuovo Cim., B
Nuovo Cimento, Il, B (Italy)

N. Y. State J. Med.
New York State Journal of Medicine (U.S.)

O

Oak Ridge Nat. Lab. Rev.
Oak Ridge National Laboratory Review (U.S.)

Obayashi-Gumi Gijutsu Kenkyusho-Ho
Obayashi-Gumi Gijutsu Kenkyusho-Ho (Report of the Engineering Research Lab., Obayashi-Gumi, Ltd.) (Japan)

Oceanology (USSR) (Engl. Transl.)
Oceanology (USSR) (English Translation of Okeanologiya) (U.S.)

Odontostomatol. Proodos
Odontostomatologike Proodos (Greece)

Oel
Oel (West Germany)

Oesterr. Akad. Wiss., Math.-Naturwiss. Kl., Sitzungsber., Abt. II
Oesterreichische Akademie der Wissenschaften, Mathematisch-Naturwissenschaftliche Klasse, Sitzungsberichte, Abteilung II (Austria)

Oesterr. Z. Erforsch. Bekaempf. Krebskrankheit
Oesterreichische Zeitschrift fuer Erforschung und Bekaempfung der Krebskrankheit (Austria)

Ohm (Elec. Mag.)
Ohm (The Electrical Magazine Ohm) (Japan)

Oikos
Oikos, Acta Oecologica Scandinavica (Denmark)

Oil Gas J.
Oil and Gas Journal, The (U.S.)

Oita-ken Onsen Chosa Kenkyu-kai Hokoku
Oita-ken Onsen Chosa Kenkyu-kai Hokoku (Japan)

Okayama Igakkai Zasshi
Okayama Igakkai Zasshi (Journal of the Okayama Medical Society) (Japan)

Oncology
Oncology (Formerly Uncologia) (Switzerland)

Onde Elec.
Onde Electrique, L (France)

Onkologiya (Sofia)
Onkologiya (Sofia) (Bulgaria)

Onsen Kagaku
Onsen Kagaku (Journal of the Balneological Society of Japan) (Japan)

Ontogenez
Ontogenez (U.S.S.R.)
Issued in English translation as Sov. J. Develop. Biol.

Opt. Commun.
Optics Communications (Netherlands)

Opto-Electronics
Opto-Electronics (England)

Opt. Spectrosc. (USSR) (Engl. Transl.)
Optics and Spectroscopy (USSR) (English Translation of Optika i Spektroskopiya) (U.S.)

Oral Surg., Oral Med., Oral Pathol.
Oral Surgery, Oral Medicine, Oral Pathology (U.S.)

Orion
Orion (Switzerland)

Orthop. Clin. N. Amer.
Orthopedic Clinics of North America (U.S.)

Osaka Kogyo Gijutsu Shikenjo Kiho
Osaka Kogyo Gijutsu Shikenjo Kiho (Bulletin of the Government Industrial Research Inst., Osaka) (Japan)

Osaka Kyoiku Daigaku Kiyo, 3
Osaka Kyoiku Daigaku Kiyo, 3 (Memoirs of the Osaka Kyoiku Univ. 3. Natural Science and Applied Science) (Japan)

Oxidation Metals
Oxidation of Metals (U. S.)

Oyo Butsuri
Oyo Butsuri (Journal of Applied Physics) (Japan)

P

Pak. J. Sci. Ind. Res.
Pakistan Journal of Scientific and Industrial Research (Pakistan)

Parasitology
Parasitology (England)

Parazitologiya
Parazitologiya (U.S.S.R.)

Particle Accel.
Particle Accelerators (Scotland)

Particles Nucl.
Particles and Nuclei (U.S.)

Pathol. Microbiol.
Pathologia et Microbiologia (Switzerland)

Patol. Fiziol. Eksp. Ter.
Patologicheskaya Fiziologiya i Eksperimentalnaya Terapiya (U.S.S.R.)

Patol. Pol.
Patologia Polska (Poland)

Pediatriya (Moscow)
Peditriya (Moscow) (U.S.S.R.)

Period. Biol.
Periodicum Biologorum (Yugoslavia)
Continues Biol. Glas.

Pestic. Biochem. Physiol.
Pesticide Biochemistry and Physiology (U.S.)

Petrol. Times
Petroleum Times, The (England)

Pharm. Acta Helv.
Pharmaceutica Acta Helvetiae (Switzerland)

Pharmazie
Pharmazie, Die (West Germany)

Pharm. Ind.
Pharmazeutische Industrie, Die (West Germany)

Philips Tech. Rev.
Philips Technical Review (Netherlands)

Phil. Mag.
Philosophical Magazine, The (England)

Phil. Trans. Roy. Soc. London, Ser. A
Philosophical Transactions of the Royal Society of London, Series A (England)

Photochem. Photobiol.
Photochemistry and Photobiology (England)

Photophysiol. Curr. Top.
Photophysiology. Current Topics (U.S.)

Photophysiology
Photophysiology (U.S.)

Photosynthetica (Prague)
Photosynthetica (Prague) (Czechoslovakia)

Phys. Bl.
Physikalische Blaetter (West Germany)

Phys. Bull. (London)
Physics Bulletin (London) (England)

Phys. Can.
Physics in Canada (Canada)

Phys. Educ.
Physics Education (England)

Phys. Fenn.
Physica Fennica (Finland)

Phys. Fluids
Physics of Fluids, The (U.S.)

Physica
Physica (Netherlands)

Physiol. Behav.
Physiology and Behavior (England)

Physiol. Bohemoslov.
Physiologia Bohemoslovaca (Czechoslovakia)

Phys. Lett.
Physics Letters (Netherlands)
Superseded by Physics Letters, A and B (Netherlands)

Phys. Lett., A
Physics Letters, (Section) A (Netherlands)

Phys. Lett., B
Physics Letters, (Section) B (Netherlands)

Phys. Med. Biol.
Physics in Medicine and Biology (England)

Phys. Metals Metallogr. (USSR) (Engl. Transl.)
Physics of Metals and Metallography, The (USSR) (English Translation of Fizika Metallov i Metallovadeniya) (England)

Phys. Norv.
Physica Norvegica (Norway)

Phys. Rep.
Physics Reports. A Review Section of Physics Letters (Section C) (Netherlands)

Phys. Rev., A
Physical Review, The, A. General Physics (U. S.)

Phys. Rev., B
Physical Review, The, B. Solid State (U. S.)

Phys. Rev., C
Physical Review, The, C. Nuclear Physics (U. S.)

Phys. Rev., D
Physical Review, The, D. Particles and Fields (U. S.)

Phys. Rev. Lett.
Physical Review Letters (U.S.)

Phys. Scr.
Physica Scripta (Sweden)
Supersedes Arkiv for Fysik

Phys. Sintering
Physics of Sintering (Yugoslavia)

Phys. Status Solidi (a)
Physica Status Solidi (a). Applied Research (East Germany)
Supersedes in part Physica Status Solidi

Phys. Status Solidi (b)
Physica Status Solidi (b). Basic Research (East Germany)
Suprsedes in part Physica Status Solidi

Phys. Technol.
Physics in Technology (England)
Supersedes Rev. Phys. Technol.

Phys. Today
Physics Today (U.S.)

Phytomorphology
Phytomorphology (India)

Planet. Space Sci.
Planetary and Space Science (England)

Planseeber. Pulvermet.
Planseeberichte fuer Pulvermetallurgie Vereinigt mit Powder Metallurgy Bulletin (Austria)

Plant Cell Physiol. (Tokyo)
Plant and Cell Physiology (Tokyo) (Japan)

Plant Physiol.
Plant Physiology (U.S.)

Plant Soil
Plant and Soil (Netherlands)

Plasma Phys.
Plasma Physics (Formerly Journal of Nuclear Energy, Part C. Plasma Physics-Accelerators-Thermonuclear Research) (England)

Plast. Massy
Plasticheskie Massy (U.S.S.R.)
Issued in English Translation as Soviet Plastics

Plast. Reconstr. Surg.
Plastic and Reconstructive Surgery and the Transplantation Bulletin (U.S.)

Plating
Plating (U.S.)

Platinum Metals Rev.
Platinum Metals Review (England)

Pochvovedenie
Pochvovedenie (U.S.S.R.)
For English Translation see Soviet Soil Science

Pochvozn. Agrokhim.
Pochvoznanie i Agrokhimiya (Bulgaria)

Pol. Arch. Med. Wewn.
Polskie Archiwum Medycyny Wewnetrznej (Poland)

Pol. Arch. Vet.
Polskie Archiwum Weterynaryjne (Poland)

Polim. Tworzywa
Polimery Tworzywa (Poland)

Pollut. Atmos.
Pollution Atmospherique (France)

Pol. Przegl. Chir.
Polski Przeglad Chirurgiczny (Poland)

Pol. Przegl. Radiol. Med. Nukl.
Polski Przeglad Radiologii i Medycyny Nuklearnej (Poland)
Issued in English Translation as Polish Review of Radiology and Nuclear Medicine

Pol. Tyg. Lek.
Polski Tygodnik Lekarski (Poland)

Poluprov. Tekh. Mikroelektron.
Poluprovodnikovaya Tekhnika i Mikroelektronika (Ukrainian S.S.R.)

Polym. J.
Polymer Journal (Japan)

Polym.-Plast. Technol. Eng.
Polymer-Plastics Technology and Engineering (U.S.)

Polytech. Tijdschr., Elektrotech./Electron.
Polytechnisch Tijdschrift, Elektrotechniek/Elektronica (Netherlands)

Polytech. Tijdschr., Procestech.
Polytechnisch Tijdschrift, Procestechniek (Netherlands)

Porosh. Met., Akad. Nauk Ukr. SSR
Poroshkovaya Metallurgiya, Akademiya Nauk Ukrainskoi SSR (Ukrainian S.S.R.)
For English Translation see Soviet Powder Metallurgy and Metal Ceramics

Postepy Astron.
Postepy Astronomii (Poland)

Postepy Astronaut.
Postepy Astronautyki (Poland)

Postepy Fiz.
Postepy Fizyki (Poland)

Postepy Fiz. Med.
Postepy Fizyki Medycznej (Poland)

Post. Tech. Jad.
Postepy Techniki Jadrowej (Poland)

Poultry Sci.
Poultry Science (U.S.)

Power (N.Y.)
Power (New York) with which are Consolidated Science and Industry, The Engineer Review, The Engineer, The Stationary Engineer, and Operating Engineer (U.S.)

Power Eng.
Power Engineering (U.S.)

Prac. Lek.
Pracovni Lekarstvi (Czechoslovakia)

Prakt. Akad. Athenon
Praktika tes Akademias Athenon (Greece)

Prakt. Lek.
Prakticky Lekar (Czechoslovakia)

Prakt. Metallog.
Praktische Metallographie (West Germany)

Pramana
Pramana (India)

Precis. Metal
Precison Metal (Formerly Precision Metal Molding) (U.S.)

Prib. Tekh. Eksp.
Pribory i Tekhnika Eksperimenta (U.S.S.R.)
For English Translation see Instruments and Experimental Techniques (USSR)

Prikl. Bioknim. Mikrobiol.
Prikladnaya Bioknimiya i Mikrobiologiya (U.S.S.R.)

Prikl. Geofiz.
Prikladnaya Geofizika (U.S.S.R.)

Pr. Inst. Masz. Przeply.
Prace Instytutu Maszyn Przeplywowych (Poland)

Probl. Endokrinol.
Problemy Endokrinologii (Formerly Problemy Endokrinologii i Gormonoterapii) (U.S.S.R.)

Probl. Gematol. Pereliv. Krovi
Problemy Gematologii i Perelivaniya Krovi (U.S.S.R.)
Issued in English Translation as Problems of Hematology and Blood Transfusion (USSR)

Probl. Kosm. Biol.
Problemy Kosmicheskoi Biologii (U.S.S.R.)

Probl. Proch. Mashinostr.
Problemy Prochnosti v Mashinostroenii (U.S.S.R.)

Probl. Prochnosti
Problemy Prochnosti (U.S.S.R.)

Proc. Amer. Power Conf.
Proceedings of the American Power Conference (U.S.)

Proc. Astron. Soc. Aust.
Proceedings of the Astronomical Society of Australia (Australia)

Proc. Cambridge Phil. Soc.
Proceedings of the Cambridge Philosophical Society (England)

Proc. Ecol. Soc. Aust.
Proceedings of the Ecological Society of Australia, The (Australia)

Proc. Hawaii. Entomol. Soc.
Proceedings of the Hawaiian Entomological Society (U.S.)

Proc. IEEE (Inst. Elec. Electron. Eng.)
Proceedings of the IEEE (Institute of Electrical and Electronics Engineers) (Formerly Proceedings of the Institute of Radio Engineers) (U.S.)

Proc. Indian Acad. Sci., Sect. A
Proceedings of the Indian Academy of Sciences, Section A (India)

Proc. Indian Nat. Sci. Acad., Part A
Proceedings of the Indian National Science Academy, Part A. Physical Sciences (Formerly Proceedings of the National Institute of Sciences of India, Part A) (India)

Proc. Inst. Elec. Eng. (London)
Proceedings of the Institution of Electrical Engineers, The (London) (England)

Proc. Inst. Mech. Eng. (London)
Proceedings of the Institution of Mechanical Engineers (London) (England)

Proc., Inst. Teknol. Bandung
Proceedings, Institut Teknologi Bandung (Indonesia)

Proc. Jap. Acad.
Proceedings of the Japan Academy (Japan)

Proc. Nat. Acad. Sci., India, Sect. A
Proceedings of the National Academy of Sciences, India, Section A (India)

Proc. Nat. Acad. Sci. U. S. A.
Proceedings of the National Academy of Sciences of the United States of America (U.S.)

Proc. Phys. Soc. (London)
Proceedings of the Physical Society (London) Changed to Journal of Physics, A, B, And C (England)

Proc. Roy. Aust. Chem. Inst.
Proceedings of The Royal Australian Chemical Institute (Australia)

Proc. Roy. Irish Acad., Sect. A
Proceedings of the Royal Irish Academy, Section A (Ireland)

Proc. Roy. Soc. Edinburgh, Sect. A
Proceedings of the Royal Society of Edinburgh, Section A. Mathematical and Physical Sciences (Scotland)

Proc. Roy. Soc. (London), Ser. A
Proceedings of the Royal Society (London), Series A (England)

Proc. Roy. Soc. Med.
Proceedings of the Royal Society of Medicine (England)

Proc. Soc. Anal. Chem.
Proceedings of the Society for Analytical Chemistry (England)

Proc. Soc. Exp. Biol. Med.
Proceedings of the Society for Experimental Biology and Medicine (U.S.)

Proc. Vib. Probl.
Proceedings of Vibration Problems (Poland)

Prod. Eng.
Product Engineering (U.S.)

Progr. Biophys. Mol. Biol.
Progress in Biophysics and Molecular Biology (Formerly Progress in Biophysics and Biophysical Chemistry) (England)

Progr. Clin. Pathol.
Progress in Clinical Pathology (U.S.)

Progr. Heat Mass Transfer
Progress in Heat and Mass Transfer (England)

Progr. Hort.
Progressive Horticulture (India)

Progr. Immunobiol. Stand.
Progress in Immunobiological Standardization (Switzerland)

Progr. Med. Chem.
Progress in Medicinal Chemistry (England)

Progr. Theor. Phys. (Kyoto)
Progress of Theoretical Physics (Kyoto) (Japan)

Progr. Theor. Phys. (Kyoto), Suppl.
Progress of Theoretical Physics (Kyoto), Supplement (Japan)

Prot. Civ. Secur. Ind.
Protection Civile et Securite Industrielle (France)

Prot. Metals (USSR) (Engl. Transl.)
Protection of Metals (USSR) (English Translation of Zashchita Metallov) (U.S.)

Przegl. Geofiz.
Przeglad Geofizyczny (Poland)

Przegl. Geol.
Przeglad Geologiczny (Poland)

Przegl. Lek.
Przeglad Lekarski (Poland)

Przem. Chem.
Przemysl Chemiczny (Poland)

Psychol. Rep.
Psychological Reports (U.S.)

PTB Mitt.
PTB Mitteilungen. Amts- und Mitteilungsblatt der Physikalisch-Technischen Bundesanstalt (West Germany)

Publ. Astron. Soc. Jap.
Publications of the Astronomical Society of Japan (Japan)

Publ. Astron. Soc. Pac.
Publications of the Astronomical Society of the Pacific (U.S.)

Publ. Tartu. Astrofiz. Observ.
Publikatsii Tartuskoi Astrofizicheskoi Observatorii (Estonian S.S.R.)

Pub. Power
Public Power (U.S.)

Pub. Util. Fortn.
Public Utilities Fortnightly (U.S.)

Pure Appl. Chem.
Pure and Applied Chemistry (The Official Journal of the International Union of Pure and Applied Chemistry) (England)

Pure Appl. Geophys.
Pure and Applied Geophysics (Formerly Geofisica Pura e Applicata) (Switzerland)

Q

Quad. Sclavo Diagn. Clin. Lab.
Quaderni Sclavo di Diagnostica Clinica e di Laboratorio (Italy)

Qual. Eng.
Quality Engineer, The (England)

Qual., Rev. Prat. Contr. Ind.
Qualite, Revue Pratique de Controle Industriel (France)

Quart. Appl. Math.
Quarterly of Applied Mathematics (U.S.)

Quart. J. Roy. Astron. Soc.
Quarterly Journal of the Royal Astronomical Society, The (England)

Quart. Rev. Biophys.
Quarterly Reviews of Biophysics (England)

R

Radiat. Bot.
Radiation Botany (England)

Radiat. Data Rep.
Radiation Data and Reports (U.S.)
Supersedes Radiological Health Data and Reports

Radiat. Eff.
Radiation Effects (England)

Radiat. Environ. Biophys.
Radiation and Environmental Biophysics (West Germany)
Continues Biophysik with Vol. 11, No. 1, 1974

Radiat. Res.
Radiation Research (U.S.)

Radiat. Res. Rev.
Radiation Research Reviews (Netherlands)

Radiats. Fiz. Nemetal. Krist.
Radiatsionnaya Fizika Nemetallicheskikh Kristallov (Ukrainian S.S.R.)

Radiats. Tekh.
Radiatsionnaya Tekhnika (U.S.S.R.)

Radiaz. Radioisotopi
Radiazioni e Radioisotopi (Italy)

Rad. Inst. Geol.-Rud. Istraz. Ispit. Nukl. Drugih Miner. Sirovina
Radovi Instituta za Geolosko-Rudarska Istrazivanja i Ispitivanja Nuklearnih i Drugih Mineralnih Sirovina (Yugoslavia)

Radiobiologiya
Radiobiologiya (U.S.S.R.)
Issued in English Translation as Radiobiology (USSR)

Radiobiol.-Radiother.
Radiobiologia-Radiotherapie (East Germany)

Radiocarbon
Radiocarbon (U.S.)

Radiochem. Radioanal. Lett.
Radiochemical and Radioanalytical Letters (Switzerland - Hungary)

Radiochim. Acta
Radiochimica Acta (West Germany)

Radio Eng. Electron. Phys. (USSR) (Engl. Transl.)
Radio Engineering and Electronic Physics (USSR) (English Translation of Radiotekhnika i Elektronika) (U.S.)

Radiography
Radiography (England)

Radioisotopes (Tokyo)
Radioisotopes (Tokyo) (Japan)

Radioisotopy
Radioisotopy (Czechoslovakia)

Radiol. Diagn.
Radiologia Diagnostica (East Germany)

Radiol. Med.
Radiologia Medica, La (Italy)

Radiology
Radiology (U.S.)

Radiol. Prot. Bull.
Radiological Protection Bulletin (England)

Radiol. Technol.
Radiologic Technology (Formerly X-Ray Technician) (U.S.)

Radioprotection
Radioprotection. Bulletin de la Societe Francaise de Radioprotection (France)

Radio Sci.
Radio Science (Formerly Journal of Research of the National Bureau of Standards, D) (U.S.)

Radiotekhnika (Moscow)
Radiotekhnika (Moscow) (U.S.S.R.)
Included in English translation in Telecommun. Radio Eng. (USSR)

Rapp. Comm. Int. Mer Mediter.
Rapport de la Commission Internationale (Pour La) Mer Mediterranee (France)

Rayonnements Ionis. Tech. Mes. Prot.
Rayonnements Ionisants Techniques de Mesures et de Protection (France)

Razved. Geofiz.
Razvedochnaya Geofizika (U.S.S.R.)

Razved. Okhr. Nedr
Razvedka i Okhrana Nedr (U.S.S.R.)

RCA Rev.
RCA Review (U.S.)

Reakts. Sposobnost Org. Soedin., Tartu. Gos. Univ.
Reaktsionnaya Sposobnost Organicheskikh Soedinenii, Tartuskii Gosudarstvennyi Universitet (Estonian S.S.R.)
Issued in English Translation as Organic Reactivity

Recherche (Paris)
Recherche, La (Paris) (France)
Supersedes Atomes (Paris) and Nucleus (Paris)

Rech. Spatial
Recherche Spatiale (France)

Rech. Vet.
Recherches Veterinaires (France)

Refractories (USSR) (Engl. Transl.)
Refractories (USSR) (English Translation of Ogneupory) (U.S.)

Reito
Reito (The Refrigeration) (Japan)

Rend. Ist. Lombardo Sci. Lett., A
Rendiconti dell'Istituto Lombardo di Scienze e Lettere, A Scienze Matematiche, Fisiche, Chimiche e Geologiche (Italy)

Rentgenol. Radiol.
Rentgenologiya i Radiologiya (Bulgaria)

Rep. Ionosphere Space Res. Jap.
Report of Ionosphere and Space Research in Japan (Japan)

Rep. Math. Phys.
Reports on Mathematical Physics (Netherlands)

Rep. Progr. Appl. Chem.
Reports on the Progress of Applied Chemistry (England)

Rep. Progr. Phys.
Reports on Progress in Physics (England)

Reprocess. Newslett.
Reprocessing Newsletter (West Germany)

Res. Commun. Chem. Pathol. Pharmacol.
Research Communications in Chemical Pathology and Pharmacology (U.S.)

Res. Exp. Med.
Research in Experimental Medicine (West Germany)
Supersedes Z. Gesam. Exp. Med. Einschl. Exp. Chir.

RES, J. Reticuloendotnel. Soc.
RES, Journal of the Reticuloendothelial Society (U.S.)

Rev. Anal. Chem.
Reviews in Analytical Chemistry. International Quarterly Scientific Reviews Journal (Israel)

Rev. Belge Med. Dent.
Revue Belge de Medecine Dentaire (Belgium)

Rev. Brasil. Fis.
Revista Brasileira de Fisica (Brazil)

Rev. Brasil. Pesquis. Med. Biol.
Revista Brasileira de Pesquisas Medicas e Biologicas (Brazil)

Rev. Can. Biol.
Revue Canadienne de Biologie (Canada)

Rev. Chil. Obstet. Ginecol.
Revista Chilena de Obstetricia y Ginecologia (Chile)

Rev. Chim. (Bucharest)
Revista de Chimie (Bucharest) (Includes Chim. Anal.) (Romania)

Rev. Chim. Miner.
Revue de Chimie Minerale (France)

Rev. Clin. Espan.
Revista Clinica Espanola (Spain)

Rev. Electrotec.
Revista Electrotecnica (Argentina)

Rev. Environ. Health
Reviews on Environmental Health (Israel)

Rev. Fr. Elec.
Revue Francaise de l'Electricite (France)

Rev. Fr. Energ.
Revue Francaise de l'Energie (France)

Rev. Gen. Caout. Plast.
Revue Generale des Caoutchoucs et Plastiques (France)

Rev. Gen. Elec.
Revue Generale de l'Electricite (France)

Rev. Gen. Therm.
Revue Generale de Thermique (France)

Rev. Geogr. Phys. Geol. Dyn.
Revue de Geographie Physique et de Geologie Dynamique (France)

Rev. Geophys. Space Phys.
Reviews of Geophysics and Space Physics (U. S.)
Supersedes Reviews of Geophysics

Rev. High-Temp. Mater.
Reviews on High-Temperature Materials (Israel)

Rev. Int. Hautes Temp. Refract.
Revue Internationale des Hautes Temperatures et des Refractaires (Formerly Revue des Hautes Temperatures et des Refractaires) (France)

Rev. Int. Oceanogr. Med.
Revue Internationale d'Oceanographie Medicale (France)

Rev. Invest. Clin. (Mex.)
Revista de Investigacion Clinica (Mexico)

Rev. Latinoamer. Microbiol. Parasitol.
Revista Latinoamericana de Microbiologia y Parasitologia (Formerly Revista Latinoamericana de Microbiologia) (Mexico)

Rev. Med. Aeronaut. Spatiale
Revue de Medecine Aeronautique et Spatiale (France)
Supersedes Rev. Med. Aeronaut. (Paris)

Rev. Med. Suisse Romande
Revue Medicale de la Suisse Romande (Switzerland)

Rev. Met. (Madrid)
Revista de Metalurgia (Madrid) (Spain)

Rev. Met. (Paris)
Revue de Metallurgie (Paris) (France)

Rev. Mex. Fis.
Revista Mexicana de Fisica (Mexico)

Rev. Mex. Fis., Supl. Fis. Apl.
Revista Mexicana de Fisica, Suplemento de Fisica Aplicada (Mexico)

Rev. Mod. Phys.
Reviews of Modern Physics (U.S.)

Rev. Phys. Appl.
Revue de Physique Appliquee (Supplement au Journal de Physique) (France)

Rev. Port. Quim. (Lisbon)
Revista Portuguesa de Quimica (Lisbon) (Portugal)

Rev. Quest. Sci.
Revue des Questions Scientifiques (Belgium)

Rev. Roum. Biochim.
Revue Roumaine de Biochimie (Romania)

Rev. Roum. Biol., Ser. Bot.
Revue Roumaine de Biologie, Serie Botanique (Romania)

Rev. Roum. Chim.
Revue Roumaine de Chimie (Continuation of Revue de Chimie, Academie de la Republique Populaire Roumaine) (Romania)

Rev. Roum. Math. Pures Appl.
Revue Roumaine de Mathematiques Pures et Appliquees (Romania)

Rev. Roum. Med. Interne
Revue Roumaine de Medecine Interne (Romania)

Rev. Roum. Phys.
Revue Roumaine de Physique (Romania)

Rev. Roum. Physiol.
Revue Roumaine de Physiologie (Romania)

Rev. Roum. Sci. Tech., Ser. Electrotech. Energ.
Revue Roumaine des Sciences Techniques, Serie Electrotechnique et Energetique (Romania)

Rev. Sanid. Hig. Publica
Revista de Sanidad e Higiene Publica (Spain)

Rev. Sci. Instrum.
Review of Scientific Instruments, The (U.S.)

Rev. Soc. Roy. Belge Ing. Ind.
Revue de la Societe Royale Belge des Ingenieurs et des Industriels (Belgium)

Rev. Soudure (Brussels)
Revue de la Soudure (Brussels) (Belgium)

Rev. Tech. Thomson-CSF
Revue Technique Thomson-CSF (Supersedes Annales de Radioelectricite and the Revue Technique Thomson-Houston) (France)

Rev. X
Revue X (Belgium)

Rikagaku Kenkyusho Hokoku
Rikagaku Kenkyusho Hokoku (Reports of the Institute of Physical and Chemical Research) (Japan)

R. I. Med. J.
Rhode Island Medical Journal, The (U.S.)

Rinsho Byori
Rinsho Byori (Japanese Journal of Clinical Pathology) (Japan)

Rinsho Hifuka
Rinsho Hifuka (Japan)

Rinsho Hinyokika
Rinsho Hinyokika (Japan)

Rinsho Hoshasen
Rinsho Hoshasen (Japanese Journal of Clinical Radiology) (Japan)

Rinsho Kagaku
Rinsho Kagaku (Japan)

Rinsho Ketsueki
Rinsho Ketsueki (Japanese Journal of Clinical Hematology) (Japan)

Rinsho Meneki
Rinsho Meneki (Japan)

Rinsho Seijinbyo
Rinsho Seijinbyo (Japan)

Rinsho Seikei Geka
Rinsho Seikei Geka (Clinical Orthopedic Surgery) (Japan)

Rinsho Seiri
Rinsho Seiri (Japan)

Rinsho Shinkeigaku
Rinsho Shinkeigaku (Clinical Neurology) (Japan)

Rinsho To Kenkyu
Rinsho To Kenkyu (The Japanese Journal of Clinical and Experimental Medicine) (Japan)

Riv. Istochim., Norm. Patol.
Rivista di Istochimica, Normale e Patologica (Italy)

Riv. Ital. Geofis.
Rivista Italiana di Geofisica (Italy)

Riv. Ital. Stomatol.
Rivista Italiana di Stomatologia (Italy)

Riv. Meteorol. Aeronaut.
Rivista di Meteorologia Aeronautica (Italy)

Riv. Nuovo Cim.
Rivista del Nuovo Cimento (Italy)
Supersedes Supplemento al Nuovo Cimento

Rocky Mt. J. Math.
Rocky Mountain Journal of Mathematics, The (U.S.)

Rocz. Akad. Med. Bialymstoku
Roczniki Akademii Medycznej im. Juliana Marchlewskiego w Bialymstoku (Poland)

Rocz. Chem.
Roczniki Chemii (Poland)

Rocz. Technol. Chem. Zywn.
Rocznik Technologii i Chemii Zywnosci (Poland)

Roentgen Bl.
Roentgen Blaetter (West Germany)

Roentgenpraxis
Roentgenpraxis (West Germany)

Rudodobiv Met. (Sofia)
Rudodobiv i Metalurgiya (Sofia) (Bulgaria)

Rudy (Prague)
Rudy (Prague) (Czechoslovakia)

Rudy Metale Niezelaz.
Rudy i Metale Niezelazne (Poland)

Russ. J. Phys. Chem. (Engl. Transl.)
Russian Journal of Physical Chemistry (English Translation of Zhurnal Fizicheskoi Khimii) (England)

S

S. Afr. J. Sci.
South African Journal of Science (South Africa)

S. Afr. Mech. Eng.
South African Mechanical Engineer, The (South Africa)

S. Afr. Med. J.
South African Medical Journal (South Africa)

S. Afr. Panorama
South African Panorama (South Africa)

Saishin Igaku
Saishin Igaku (Modern Medicine) (Japan)

Samoletostr. Tekh. Vozdush. Flota
Samoletostroenie i Tekhnika Vozdushnogo Flota (Ukrainian S.S.R.)

SAMPE Quart.
SAMPE Quarterly (U.S.)

Sanfujinka Chiryo
Sanfujinka Chiryo (Obstetrical and Gynecological Therapy) (Japan)

Sanfujinka No Shimpo
Sanfujinka No Shimpo (Advances in Obstetrics and Gynecology) (Japan)

Sapere
Sapere (Italy)

Sapporo Igaku Zasshi
Sapporo Igaku Zasshi (The Sapporo Medical Journal) (Japan)

Sb. Nauch. Tr., Mosk. Tekhnol. Inst. Pishch. Prom.
Sbornik Nauchnykh Trudov, Moskovskii Tekhnologicheskii Institut Pishchevoi Promyshlennosti (U.S.S.R.)

Sb. Nauch. Tr., Tomsk. Inzh.-Stroit. Inst.
Sbornik Nauchnykh Trudov, Tomskii Inzhenerno-Stroitel'nyi Institut (U.S.S.R.)

Sb. Statei, Mosk. Inzh.-Fiz. Inst.
Sbornik Statei, Moskovskii Inzhenerno-Fizicheskii Institut (U.S.S.R.)

Sb. Tr., Mosk. Vech. Met. Inst.
Sbornik Trudov, Moskovskii Vechernii Metallurgicheskii Institut (U.S.S.R.)

Sb. Ved. Udbornych Pr., Zavodni Ustav Narodniho Zadravi Uranoveho Prum., Pribram
Sbornik Vedeckych a Udbornych Praci, Zavodni Ustav Narodniho Zdravi Uranoveho Prumyslu, Pribram (Czechoslovakia)

Sb. Ved. Pr. Lek. Fak. Karlovy Univ. Hradci Kralove, Suppl.
Sbornik Vedeckych Praci Lekarske Fakulty Karlovy University v Hradci Kralove, Supplementum (Czechoslovakia)

Sb. Ved. Pr. VLVDU Hradci Kralove
Sbornik Vedeckych Praci VLVDU (Vojenskeho Lekarskeho Vyzkumneho a Doskolovacino Ustavu) JEP v Hradci Kralove (Czechoslovakia)

Sb. Vys. Sk. Zemed. Praze, Fak. Agron., Rada A
Sbornik Vysoke Skoly Zemedelske v Praze, Fakulta Agronomicka, Rada A. Rostlinna Vyroba (Czechoslovakia)

Scand. J. Clin. Lab. Invest.
Scandinavian Journal of Clinical and Laboratory Investigation (Norway)

Scand. J. Dent. Res.
Scandinavian Journal of Dental Research (Denmark)

Scand. J. Gastroenterol.
Scandinavian Journal of Gastroenterology (Norway)

Scand. J. Haematol.
Scandinavian Journal of Haematology (Denmark)

Scand. J. Resp. Dis.
Scandinavian Journal of Respiratory Diseases (Formerly Acta Tuberculosea et Pneumologica Scandinavica) (Denmark)

Scand. J. Urol. Nephrol.
Scandinavian Journal of Urology and Nephrology (Sweden)

Schiff Hafen
Schiff und Hafen (west Germany)

Schweissen Schneiden
Schweissen und Schneiden (West Germany)

Schweiz. Bauztg.
Schweizerische Bauzeitung (Switzerland)

Schweiz. Med. Wochensch.
Schweizerische Medizinische Wochenschrift (Switzerland)

Sci. Amer.
Scientific American (U.S.)

Sci. Avenir
Sciences et Avenir (France)

Sci. Cult. (Calcutta)
Science and Culture (Calcutta) (India)

Science
Science (U.S.)

Sci. Eng. Rep., Saitama Univ., Ser. C
Science and Engineering Reports of Saitama University, Series C, The (Japan)

Sci. Forum
Science Forum (Canada)

Sci. Pap. Inst. Phys. Chem. Res. (Jap.)
Scientific Papers of the Institute of Physical and Chemical Research (Japan) (Formerly Journal of the Scientific Research Institute (Japan)) (Japan)

Sci. Progr. (Oxford)
Science Progress (Oxford) (England)

Sci. Rep.
Science Reporter (U.S.)

Sci. Rep. Res. Inst., Tohoku Univ., Ser. C
Science Reports of the Research Institutes, Tohoku University, Series C. Medicine (Japan)

Sci. Rep. Tohoku Univ., First Ser.
Science Reports of the Tohoku University, First Series (Japan)

Sci. Rep. Tohoku Univ., Seventh Ser.
Science Reports of the Tohoku University, Seventh Series (Japan)

Sci. Sinica (Peking)
Scientia Sinica (Peking) (Chung Kuo Ko Hsueh) (China)
Discontinued

Sci. Tech. (Paris)
Sciences et Techniques (Paris) (France)

Sci. Today (Bombay)
Science Today (Bombay) (India)

Scr. Met.
Scripta Metallurgica (U.S.)

Search
Search. Science, Technology and Society (Australia)
Supersedes Australian Journal of Science

Securitas
Securitas (Italy)

Seibutsu Butsuri
Seibutsu Butsuri (Journal of the Biophysical Society of Japan) (Japan)

Seibutsu Kagaku
Seibutsu Kagaku (Biological Science) (Japan)

Seifen-Oele-Fette-Wachse
Seifen-Oele-Fette-Wachse (West Germany)

Seisan Kenkyu
Seisan Kenkyu (Monthly Journal of the Institute of Industrial Science, University of Tokyo) (Japan)

Semento Konkurito
Semento Konkurito (Cement and Concrete) (Japan)

Sem. Hop. Paris
Semaine des Hopitaux de Paris, La (France)

Seminars Hematol.
Seminars in Hematology (U.S.)

Semin. Nucl. Med.
Seminars in Nuclear Medicine (U.S.)

Senpaku Gijutsu Kenkyujo Hokoku
Senpaku Gijutsu Kenkyujo Hokoku (Report of Ship Research Institute) (Japan)

Senten Ijo
Senten Ijo (Congenital Anomalies) (Japan)

Seoul Nat. Univ. Fac. Pap., Sci. Technol. Ser. C
Seoul National University Faculty Papers, Science and Technology Series C (Soul Taehakkyo) (South Korea)

Separ. Purif. Methods
Separation and Purification Methods (U.S.)
Supplement to Separation Science

Separ. Sci.
Separation Science (U.S.)

Shigen
Shigen (Resources) (Japan)

Shikoku Igaku Zasshi
Shikoku Igaku Zasshi (Shikoku Acta Medica) (Japan)

Shimadzu Hyoron
Shimadzu Hyoron (Shimadzu Review) (Japan)

Shindan To Chiryo
Shindan To Chiryo (Diagnosis and Treatment) (Japan)

Shin Kinzoku
Shin Kinzoku (New Metals and Technics) (Japan)

Shin Kinzoku Kogyo
Shin Kinzoku Kogyo (Newer Metal Industry) (Japan)

Shinku
Shinku (Journal of the Vacuum Society of Japan) (Japan)

Shinryo To Shinyaku
Shinryo To Shinyaku (Medical Consultation and New Remedies) (Japan)

Shinshu Daigaku Kogakubu Kiyo
Shinshu Daigaku Kogakubu Kiyo (Journal of the Faculty of Engineering, Shinshu University) (Japan)

Shinshu Igaku Zasshi
Shinshu Igaku Zasshi (The Shinshu Medical Journal) (Japan)

Shinyaku To Rinsho
Shinyaku To Rinsho (Journal of New Remedies and Clinic) (Japan)

Shitsuryo Bunseki
Shitsuryo Bunseki (Mass Spectroscopy) (Japan)

Shizuoka-Ken Kogyo Shikenjo Hokoku
Shizuoka-Ken Kogyo Shikenjo Hokoku (Japan)

Shock Vib. Bull.
Shock and Vibration Bulletin, The (U. S.)

Shokuhin Eiseigaku Zasshi
Shokuhin Eiseigaku Zasshi (Journal of the Food Hygienic Society of Japan) (Japan)

Shoni Igaku
Shoni Igaku (Japan)

Shonika
Shonika (Japan)

Shonika Rinsho
Shonika Rinsho (Japanese Journal of Pediatrics) (Japan)

SIAM (Soc. Ind. Appl. Math.) J. Appl. Math.
SIAM (Society For Industrial and Applied Mathematics) Journal on Applied Mathematics (Formerly Journal of the Society for Industrial and Applied Mathematics) (U.S.)

SIAM (Soc. Ind. Appl. Math.) J. Numer. Anal.
SIAM (Society for Industrial and Applied Mathematics) Journal on Numerical Analysis (U. S.)

Sicherheitsingerieur
Sicherheitsingerieur (West Germany)

Siemens Forsch.-Entwicklungsber.
Siemens Forschungs-und Entwicklungsberichte (West Germany)

Siemens-Z.
Siemens-Zeitschrift (West Germany)

Singapore Med. J.
Singapore Medical Journal (Singapore)

Sivilt Beredskap
Sivilt Beredskap (Norway)

Skoda Rev.
Skoda Review (Czechoslovakia)

Sky Telesc.
Sky and Telescope (U.S.)

Slevarenstvi
Slevarenstvi (Czechoslovakia)

S. Med. J.
Southern Medical Journal (U.S.)

Soc. Astron. Ital., Mem.
Societa Astronomica Italiana, Memorie (Italy)

Sogo Rinsho
Sogo Rinsho (Clinic All-round) (Japan)

Soil Biol. Biochem.
Soil Biology and Biochemistry (England)

Soil Sci. Soc. Amer., Proc.
Soil Science Society of America, Proceedings (U.S.)

Solar Energy
Solar Energy. Journal of Solar Energy Science and Engineering (U.S.)

Solar Phys.
Solar Physics (Netherlands)

Solid State Commun.
Solid State Communications (England-U.S.)

Solid-State Electron.
Solid-State Electronics. An International Journal (England)

Soobshch. Akad. Nauk Gruz. SSR
Soobshcheniya Akademii Nauk Gruzinskoi SSR (Georgian S.S.R.)

Soobshch. Byurakan. Observ., Akad. Nauk Arm. SSR
Soobshcheniya Byurakanskoi Observatorii, Akademiya Nauk Armyanskoi SSR (Armenian S.S.R.)

Soudage Tech. Connexes
Soudage et Techniques Connexes (France)

Sov. Astron. AJ (Engl. Transl.)
Soviet Astronomy-AJ (English Translation of Astronomicheskii Zhurnal) (U.S.)

Sov. At. Energy (Engl. Transl.)
Soviet Atomic Energy (English Translation of Atomnaya Energiya) (U.S.)

Sov. Electrochem. (Engl. Transl.)
Soviet Electrochemistry (English Translation of Elektrokhimiya) (U.S.)

Sov. Genet. (Engl. Transl.)
Soviet Genetics (English Translation of Genetika) (U.S.)

Sov. Geol.
Sovetskaya Geologiya (U.S.S.R.)

Sov. J. At. Energy (Engl. Transl.)
Soviet Journal of Atomic Energy, The (English Translation of Atomnaya Energiya) (U.S.)
Changed to Sov. At. Energy

Sov. J. Develop. Biol. (Engl. Transl.)
Soviet Journal of Developmental Biology (English Translation of Ontogenez) (U.S.)

Sov. J. Ecol. (Engl. Transl.)
Soviet Journal of Ecology (English Translation of Ekologiya) (U.S.)

Sov. J. Nondestruct. Test. (Engl. Transl.)
Soviet Journal of Nondestructive Testing (English Translation of Defektoskopiya) (U. S.)

Sov. J. Opt. Technol.
Soviet Journal of Optical Technology (U.S.)
English translation of Opt.-Mekh. Prom.

Sov. J. Particles Nucl.
Soviet Journal of Particles and Nuclei (U.S.)
English translation of Fiz. Elem. Chastits At. Yadra

Sov. J. Quantum Electron.
Soviet Journal of Quantum Electronics (U.S.)
English translation of Kvantovaya Elektron. (Moscow)

Sov. Med.
Sovetskaya Meditsina (U.S.S.R.)

Sov. Phys.-Cryst. (Engl. Transl.)
Soviet Physics-Crystallography (English Translation of Kristallografiya) (U.S.)

Sov. Phys. - Dokl. (Engl. Transl.)
Soviet Physics - Doklady (English Translation of Doklady Akademiya Nauk SSSR (physics sections, except geophysics and biophysics)) (U.S.)

Sov. Phys.-Semicond. (Engl. Transl.)
Soviet Physics-Semiconductors (English Translation of Fizika i Tekhnika Poluprovodnikov) (U.S.)

Sov. Phys.-Solid State (Engl. Transl.)
Soviet Physics-Solid State (English Translation of Fizika Tverdogo Tela) (U.S.)

Sov. Phys.-Tech. Phys. (Engl. Transl.)
Soviet Physics-Technical Physics (English Translation of Zhurnal Tekhnicheskoi Fiziki) (U.S.)

Sov. Radiochem. (Engl. Transl.)
Soviet Radiochemistry (English Translation of Radiokhimiya) (U.S.)

Sov. Zdravookhr. Kirg.
Sovetskoe Zdravookhranenie Kirgizii (Kirghiz S.S.R.)

Space Sci. Rev.
Space Science Reviews (Netherlands)

SPARMO Bull.
SPARMO Bulletin. Solid Particles and Radiation Monitoring Organization (France)

Spectrochim. Acta
Spectrochimica Acta (England)
Superseded by Spectrochimica Acta, Part A and Part B

Spectrochim. Acta, Part A
Spectrochimica Acta, Part A. Molecular Spectroscopy (England)

Spectrosc. Lett.
Spectroscopy Letters (U.S.)

Springer Tracts Mod. Phys.
Springer Tracts in Modern Physics. Ergebnisse der Exakten Naturwissenschaften (West Germany)

Staerke
Staerke, Die (West Germany)

Stahl Eisen
Stahl und Eisen (West Germany)

Stal
Stal (U.S.S.R.)

Staub-Reinhalt. Luft
Staub-Reinhaltung der Luft (West Germany)

Sterne Weltraum
Sterne und Weltraum (West Germany)

Steroids
Steroids. An International Journal (U.S.)

Steuerungstechnik
Steuerungstechnik (West Germany)

Stiinta Solului
Stiinta Solului (Romania)

Stimulation Newslett.
Stimulation Newsletter (West Germany)

Stomatologiya (Moscow)
Stomatologiya (Moscow) (U.S.S.R.)

Strahlentherapie
Strahlentherapie (West Germany)

Strength Mater. (USSR) (Engl. Transl.)
Strength of Materials (USSR) (English Translation of Problemy Prochnosti) (U. S.)

Strojirenstvi
Strojirenstvi (Czechoslovakia)

Strojnicky Cas.
Strojnicky Casopis (Czechoslovakia)

Stroke
Stroke (U.S.)

Stud. Biophys.
Studia Biophysica (East Germany)

Stud. Cercet. Astron.
Studii si Cercetari de Astronomie (Romania)

Stud. Cercet. Chim.
Studii si Cercetari de Chimie (Romania)

Stud. Cercet. Endocrinol.
Studii si Cercetari de Endocrinologie (Romania)

Stud. Cercet. Energ. Electroten.
Studii si Cercetari de Energetica si Electrotennica (Romania)

Stud. Cercet. Fiz.
Studii si Cercetari de Fizica (Formerly Academia Republicii Populare Romine, Institutul de Fizica Atomica si Institutul de Fizica, Studii si Cercetari de Fizica) (Romania)

Stud. Cercet. Geol., Geofiz., Geogr., Ser. Geofiz.
Studii si Cercetari de Geologie, Geofizica, Geografie, Seria Geofizica (Romania)

Stud. Cercet. Mat.
Studii si Cercetari Matematice (Romania)

Stud. Geophys. Geod.
Studia Geophysica et Geodaetica, Ceskoslovenska Akademie Ved (Czechoslovakia)

Stud. Pneumol. Phtiseol. Cech.
Studia Pneumologica et Phtiseologica Cechoslovaca (Czechoslovakia)

Stud. Sci. Math. Hung.
Studia Scientiarum Mathematicarum Hungarica (Hungary)

Stud. Univ. Babes-Bolyai, Ser. Chem.
Studia Universitatis Babes-Bolyai, Series Chemia (Romania)

Stud. Univ. Babes-Bolyai, Ser. Math.-Phys.
Studia Universitatis Babes-Bolyai, Series Mathematica-Physica (Romania)

Stud. Univ. Babes-Bolyai, Ser. Phys.
Studia Universitatis Babes-Bolyai, Series Physica (Romania)
Continues in part Studia Universitatis Babes-Bolyai, Series Mathematica-Physica

Sulzer Tech. Rev.
Sulzer Technical Review (Switzerland)

Sumitomo Jukikai Giho
Sumitomo Jukikai Giho (Japan)

Surface Sci.
Surface Science (Netherlands)

Surg. Clin. N. Amer.
Surgical Clinics of North America, The (U.S.)

Surveyor (N.Y.)
Surveyor (New York) (U.S.)

Suvrem. Med.
Suvremenna Meditsina (Bulgaria)

Svar. Proizv.
Svarochnoe Proizvodstvo (U.S.S.R.)
Issued in English Translation as Welding Production (USSR)

Svetsen
Svetsen (Sweden)

Sv. Forfattningssamling
Svensk Forfattningssamling (Sweden)

Sv. Tandlakareforb. Tidn.
Sveriges Tandlakareforbunds Tidning (Sweden)

Symbioses
Symbioses (France)

Syn. Inorg. Metal-Org. Chem.
Synthesis in Inorganic and Metal-Organic Chemistry (U.S.)

Szklo Ceram.
Szklo i Ceramika (Poland)

T

Taiki Hosnano Kansoku Seiseki
Taiki Hosnano Kansoku Seiseki (Bulletin of the Atmospheric Radioactivity) (Japan)

Talanta
Talanta (England)

Tecn. J., Ankara Nucl. Res. Cent.
Technical Journal, Ankara Nuclear Research Center (Turkey)

Tech. Mitt.
Technische Mitteilungen (West Germany)

Tech. Mitt. Krupp, Forschungsber.
Technische Mitteilungen Krupp, Forschungsberichte (West Germany)

Tech. Mod.
Technique Moderne, La (France)

Technica (Basel)
Technica (Basel) (Switzerland)

Technol.-Nachr. Manage.-Inform.
Tecanologie-Nachrichten Management-Informationen (West Germany)

Technol.-Nachr. Sonderienst-Program.
Technologie-Nachricaten Sonderdienst-Programme (West Germany)

Tecnnology (Sindri)
Technology (Sindri). Quarterly Bulletin of the Planning and Development Div., Fertilizer Corp. of India Ltd. (India)

Technol. Rep. Tohoku Univ.
Technology Reports of the Tohoku University (Japan)

Technol. Rev.
Technology Review (U.S.)

Tecn. Poszukiwan
Technika Poszukiwan (Poland)

Tech. Rep. Inst. At. Energy, Kyoto Univ.
Technical Reports of the Institute of Atomic Energy, Kyoto University (Japan)
Supersedes Tech. Rep. Eng. Res. Inst., Kyoto Univ.

Tech. Ueberwach.
Technische Ueberwachung (West Germany)

Tech. Zukunft
Techniken der Zukunft (West Germany)

Tegnikon
Tegnikon (South Africa)

Tehnika (Belgrade)
Tehnika (Belgrade) (Yugoslavia)

Tek. Tidskr.
Teknisk Tidskrift (Sweden)

Tek. Ukebl.
Teknisk Ukeblad (Norway)

Tensai Kenkyu Hokoku, Suppl.
Tensai Kenkyu Hokoku, Supplement (Bulletin of Sugar Beet Research, Supplement) (Japan)

Teor. Eksp. Khim.
Teoreticheskaya i Eksperimental'naya Khimiya (Ukrainian S.S.R.)
Issued in English Translation as Theoretical and Experimental Chemistry (USSR)

Teor. Mat. Fiz.
Teoreticheskaya i Matematicheskaya Fizika (U.S.S.R.)

Teplofiz. Teplotekn.
Teplofizika i Teplotekhnika (Ukrainian S.S.R.)

Teplofiz. Vys. Temp.
Teplofizika Vysokikh Temperatur (U.S.S.R.)
Issued in English Translation as High Temperature (USSR)

Termotecnica (Milan)
Termotecnica, La (Milan) (Italy)

Tetrahedron Lett.
Tetrahedron Letters (England)

Tetsu To Hagane
Tetsu To Hagane (Journal of the Iron and Steel Institute) (Japan)

Theor. Appl. Genet.
Theoretical and Applied Genetics (Formerly Zuechter. Genetics and Breeding Research) (West Germany)

Theory Probab. Its Appl. (USSR) (Engl. Transl.)
Theory of Probability and Its Applications (USSR) (English Translation of Teoriya Veroyatnostei i ee Primeneniya) (U.S.)

Therapiewoche
Therapiewoche, Die (West Germany)

Ther. Gegenw.
Therapie der Gegenwart (West Germany)

Therm. Eng. (USSR) (Engl. Transl.)
Thermal Engineering (USSR) (English Translation of Teploenergetika) (England - U.S.)

Thermochim. Acta
Thermochimica Acta (Netherlands)

Thin Solid Films
Thin Solid Films (Switzerland)

Thoraxchir. Vask. Chir.
Thoraxchirurgie und Vaskulaere Chirurgie (Formerly Thoraxchirurgie) (West Germany)

Thyssenforschung
Thyssenforschung (West Germany)

Ti Chih Ko Hsueh
Ti Chih Ko Hsueh (Geological Science) (China)

Tidsskr. Norske Laegforen.
Tidsskrift for den Norske Laegeforening (Norway)

Toho Igakkai Zasshi
Toho Igakkai Zasshi (Journal of the Medical Society of Toho University) (Japan)

Tohoku Daigaku Hisuiyoeki Kagaku Kenkyusho Hokoku
Tohoku Daigaku Hisuiyoeki Kagaku Kenkyusho Hokoku (Bulletin of the Chemical Research Inst. of Non-Aqueous Solutions, Tohoku University) (Japan)

Tohoku Daigaku Kagaku Keisoku Kenkyusho Hokoku
Tohoku Daigaku Kagaku Keisoku Kenkyusho Hokoku (Bulletin of the Research Institute for Scientific Measurements, Tohoku University) (Japan)

Tohoku Daigaku Senko Seiren Kenkyusho Iho
Tohoku Daigaku Senko Seiren Kenkyusho Iho (Bulletin of the Research Inst. of Mineral Dressing and Metallurgy, Tohoku University) (Japan)

Tohoku Igaku Zasshi
Tohoku Igaku Zasshi (Tohoku Medical Journal) (Japan)

Tohoku J. Exp. Med.
Tohoku Journal of Experimental Medicine, the (Japan)

Tokai Daigaku Kiyo Kogakubu
Tokai Daigaku Kiyo Kogakubu (Proceedings of the Faculty of Engineering, of Tokai University (Japan)

Tokushuko
Tokushuko (Special Steel) (Japan)

Tokyo Daigaku Kogakubu Fuzoku Sogo Shikenjo Nenpo
Tokyo Daigaku Kogakubu Fuzoku Sogo Shikenjo Nenpo (Report of Engineering Inst., Faculty of Engineering, Tokyo University) (Japan)

Tokyo Daigaku Uchu Koku Kenkyusho Hokoku
Tokyo Daigaku Uchu Koku Kenkyusho Hokoku (Bulletin of the Institute of Space and Aeronautical Science, University of Tokyo) (Japan)

Tokyo Igaku
Tokyo Igaku (Japan)
Supersedes Tokyo Igaku Zasshi

Tokyo Igaku Zasshi
Tokyo Igaku Zasshi (The Tokyo Journal of Medical Sciences) (Japan)
Changed to Tokyo Igaku

Tokyo Ika Daigaku Zasshi
Tokyo Ika Daigaku Zasshi (The Journal of Tokyo Medical College) (Japan)

Tokyo Jikeikai Ika Daigaku Zasshi
Tokyo Jikeikai Ika Daigaku Zasshi (Tokyo Jikeikai Medical Journal) (Japan)

Tokyo Joshi Ika Daigaku Zasshi
Tokyo Joshi Ika Daigaku Zasshi (Journal of Tokyo Women's Medical College) (Japan)

Tokyo Kogyo Shikensho Hokoku
Tokyo Kogyo Shikensho Hokoku (Reports of the Government Chemical Industrial Research Institute, Tokyo) (Japan)
Changed to J. Nat. Chem. Lab. Ind.

Tonyobyo
Tonyobyo (Diabetes Mellitus) (Japan)

Toryo No Kenkyu
Toryo No Kenkyu (Studies in Paint) (Japan)

Toshiba Rebyu
Toshiba Rebyu (Toshiba Review) (Japan)

Toxicol. Appl. Pharmacol.
Toxicology and Applied Pharmacology (U.S.)

Toxicology
Toxicology (Netherlands)

Toyama Daigaku Kogakubu Kiyo
Toyama Daigaku Kogakubu Kiyo (Bulletin of the Faculty of Engineering, Toyama University) (Japan)

Trait. Surface
Traitements de Surface (France)

Trans. Amer. Nucl. Soc.
Transactions of the American Nuclear Society (U.S.)

Trans. Amer. Nucl. Soc., Suppl.
Transactions of the American Nuclear Society, Supplement (U.S.)

Trans. Amer. Soc. Artif. Intern. Organs
Transactions, American Society for Artificial Internal Organs (U.S.)

Trans. Bose Res. Inst. (Calcutta)
Transactions of the Bose Research Institute (Calcutta) (India)

Trans. Brit. Mycol. Soc.
Transactions of the British Mycological Society (England)

Trans. Can. Inst. Mining Met.
Transactions of the Canadian Institute of Mining and Metallurgy and of the Mining Society of Nova Scotia (Canada)

Trans. Can. Soc. Mech. Eng.
Transactions of the Canadian Society for Mechanical Engineering (Canada)

Trans. Indian Ceram. Soc.
Transactions of the Indian Ceramic Society (India)

Trans. Iron Steel Inst. Jap.
Transactions of the Iron and Steel Institute of Japan (Japan)

Trans. Jap. Inst. Metals
Transactions of the Japan Institute of Metals (Sendai) (Japan)

Trans. J. Brit. Ceram. Soc.
Transactions and Journals of the British Ceramic Society (Incorporating British Ceramic Abstracts) (England)
Supersedes J. Brit. Ceram. Soc. and Trans. Brit. Ceram. Soc.

Transplantation
Transplantation (Formerly Transplantation Bulletin) (U.S.)

Transplant. Proc.
Transplantation Proceedings (U.S.)

Transp. Theory Statist. Phys.
Transport Theory and Statistical Physics (U.S.)

Trans. S. Afr. Inst. Elec. Eng.
Transactions of the South African Institute of Electrical Engineers (South Africa)

Trans. Soc. Advan. Electrochem. Sci. Technol.
Transactions of the Society for Advancement of Electrochemical Science and Technology (India)

Trans. Soc. Occup. Med.
Transactions of the Society of Occupational Medicine (England)

Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR
Trudy Astrofizicheskogo Instituta, Akademiya Nauk Kazakhskoi SSR (Kazakh S.S.R.)

Tr., Atl. Nauch.-Issled. Inst. Ryb. Khoz. Okeanogr.
Trudy, Atlanticheskii Nauchno-Issledovatel'skii Institut Rybnogo Khozyaistva i Okeanografii (U.S.S.R.)

Tr. Fiz. Inst., Akad. Nauk SSSR
Trudy Fizicheskogo Instituta Imeni P. N. Lebedeva, Akademiya Nauk SSSR (U.S.S.R.)
Issued in English Translation as Proceedings (Trudy) of the P. N. Lebedev Physics Institute

Tr. Gl. Geofiz. Observ.
Trudy Glavnoi Geofizicheskoi Observatorii (U.S.S.R.)

Tr. Gos. Nauch.-Issled. Inst. Gornokhim. Syr'ya
Trudy Gosudarstvennogo Nauchno-Issledovatel'skogo Instituta Gornokhimicheskogo Syr'ya (U.S.S.R.)

Tr. Inst. Bot., Akad. Nauk Kaz. SSR
Trudy Instituta Botaniki, Akademiya Nauk Kazakhskoi SSR (Kazakh S.S.R.)

Tr., Inst. Eksp. Meteorol.
Trudy, Institut Eksperimental'noi Meteorologii (U.S.S.R.)

Tr. Inst. Elektrokhim., Ural. Nauch. Tsentr. Akad. Nauk SSSR
Trudy Instituta Elektrokhimii, Ural'skii Nauchnyi Tsentr, Akademiya Nauk SSSR (U.S.S.R.)
Supersedes Tr. Inst. Elektrokhim., Akad. Nauk SSSR, Ural. Filial

Tr. Inst. Fiz. Astron., Akad. Nauk Est. SSR
Trudy Instituta Fiziki i Astronomii, Akademiya Nauk Estonskoi SSR (Estonian S.S.R.)

Tr. Inst. Fiz. Metal. Ural. Nauch. Tsent., Akad. Nauk SSSR
Trudy Instituta Fiziki Metallov Ural'skogo Nauchnogo Tsentra, Akademiya Nauk SSSR (U.S.S.R.)

Tr. Inst. Khim., Akad. Nauk SSSR, Ural. Filial
Trudy Instituta Khimii, Akademiya Nauk SSSR, Ural'skii Filial (U.S.S.R.)

Tr. Inst. Khim., Ural. Nauch. Tsentr, Akad. Nauk SSSR
Trudy Instituta Khimii Ural'skii Nauchnyi Tsentr, Akademiya Nauk SSSR (U.S.S.R.)
Supersedes Tr. Inst. Khim., Akad. Nauk SSSR, Ural Filial

Tr. Inst. Mikrobiol. Virusol., Akad. Nauk Kaz. SSR
Trudy Instituta Mikrobiologii i Virusologii Akademiya Nauk Kazakhskoi SSR (Kazakh S.S.R.)

Tr. Inst. Okeanol., Akad. Nauk SSSR
Trudy Instituta Okeanologii, Akademiya Nauk SSSR (U.S.S.R.)

Tr. Inst. Org. Katal. Elektrokhim., Akad. Nauk Kaz. SSR
Trudy Instituta Organicheskogo Kataliza i Elektrokhimii, Akademiya Nauk Kazakhskoi SSR (Kazakh S.S.R.)

Tr. Leningrad. Korablestroitel'nogo Inst.
Trudy Leningradskogo Korablestroitel'nogo Instituta (U.S.S.R.)

Tr. Mosk. Energ. Inst.
Trudy Moskovskogo Energeticheskogo Instituta (U.S.S.R.)

Tr. Mosk. Energ. Inst., Fiz.
Trudy Moskovskogo ordena Lenina Energeticheskogo Instituta, Fizika (U.S.S.R.)

Tr. Mosk. Inst. Radiotekh., Elektron. Avtomat.
Trudy Moskovskogo Instituta Radiotekhniki, Elektroniki i Avtomatiki (U.S.S.R.)

Tr. Mosk. Khim.-Tekhnol. Inst.
Trudy Moskovskogo Khimiko-Tekhnologicheskogo Instituta imeni D. I. Mendeleeva (U.S.S.R.)

Tr. Nauch.-Issled. Inst. Kraev. Patol., Alma-Ata
Trudy Nauchno-Issledovatel'skogo Instituta Kraevoi Patologii, Alma-Ata (Kazakh S.S.R.)

Tr. Nauch.-Issled. Inst. Onkol. Gruz. SSR
Trudy Nauchno-Issledovatel'skogo Instituta Onkologii Gruzinskoi SSR (Georgian S.S.R.)

Tr. Nikolaev. Korablestroit. Inst.
Trudy Nikolaevskogo Korablestroitel'nogo Instituta (Ukrainian S.S.R.)

Tr. Radiotekh. Inst.
Trudy Radiotekhnicheskogo Instituta (U.S.S.R.)

Tr. Ryazan. Radiotekh. Inst.
Trudy Ryazanskogo Radiotekhnicheskogo Instituta (U.S.S.R.)

Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.
Trudy Soyuznogo Nauchno-Issledovatel'skogo Instituta Priborostroeniya (U.S.S.R.)

Tr. Tadzh. Gos. Med. Inst.
Trudy Tadzhikskogo Gosudarstvennogo Meditsinskogo Instituta (Tadzhik S.S.R.)

Tr. Tsent. Aerol. Observ.
Trudy Tsentral'noi Aerologicheskoi Observatorii (U.S.S.R.)

Tr. Ural. Politekh. Inst.
Trudy Ural'skogo Politekhnicheskogo Instituta imeni S. M. Kirova (U.S.S.R.)

Tr. Vses. Nauch.-Issled. Inst. Gidrotekh. Melior.
Trudy Vsesoyuznogo Nauchno-Issledovatel'skogo Instituta Gidrotekhniki i Melioratsii (U.S.S.R.)

Tr., Vses. Nauch.-Issled. Inst. Khim. Reaktivov Osobo Chist. Khim. Veshchestv
Trudy, Vsesoyuznyi Nauchno-Issledovatel'skii Institut Khimicheskikh Reaktivov i Osobo Chistykh Khimicheskikh Veshchestv (U.S.S.R.)

Tr., Vses. Nauch.-Issled. Inst. Radiats. Tekh.
Trudy, Vsesoyuznyi Nauchno-Issledovatel'skii Institut Radiatsionnoi Tekhniki (U.S.S.R.)

Tr., Vses. Nauch.-Issled. Inst. Yadern. Geofiz. Geokhim.
Trudy, Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofiziki i Geokhimii (U.S.S.R.)

Tr. Vses. Nauch.-Issled. Inst. Zolota Redk. Metal.
Trudy Vsesoyuznogo Nauchno-Issledovatel'skogo Instituta Zolota i Redkikh Metallov (U.S.S.R.)

Tsirk. Shemakh. Astrofiz. Observ.
Tsirkulyar Shemakhinskoi Astrofizicheskoi Observatorii (Azerbadizhan S.S.R.)

Tsitol. Genet.
Tsitologiya i Genetika (Ukrainian S.S.R.)

Tsitologiya
Tsitologiya (U.S.S.R.)

Tsvetn. Metal.
Tsvetnye Metally (U.S.S.R.)
For English Translation see the Soviet Journal of Non-Ferrous Metals

Tunisie Med.
Tunisie Medicale (Tunisia)

Tungsten News
Tungsten News (U.S.)

U

Uchusen Kenkyu
Uchusen Kenkyu (Studies of Cosmic Ray) (Japan)

Uch. Zap. Azerb. Gos. Univ., Ser. Khim. Nauk
Uchenye Zapiski Azerbaidzhanskogo Gosudarstvennogo Universiteta Im. S. M. Kirova, Seriya Khimicheskikh Nauk (Azerbaidzhan S.S.R.)

Uch. Zap., Azerb. Inst. Nefti Khim., Ser. 9
Uchenye Zapiski, Azerbaidzhanskii Institut Nefti i Khimii, Seriya 9 (Azerbaidzhan S.S.R.)

Ugeskr. Laeger
Ugeskrift for Laeger (Denmark)

Ukr. Biokhim. Zh.
Ukrainskii Biokhimicnnii Zhurnal (Ukrainian S.S.R.)

Ukr. Fiz. Zh. (Russ. Ed.)
Ukrainskii Fizicheskii Zhurnal (Russian Edition) (Ukrainian S.S.R.)

Ukr. Fiz. Zh. (Ukr. Ed.)
Ukrainskii Fizichnii Zhurnal (Ukrainian Edition) (Ukrainian S.S.R.)

Ukr. Khim. Zh.
Ukrainskii Khimicheskii Zhurnal (Ukrainian S.S.R.)
Issued in English Translation as Soviet Progress in Chemistry

Umsch. Wiss. Tech.
Umschau in Wissenschaft und Technik (West Germany)

Umwelt
Umwelt (West Germany)

Union Med. Can.
Union Medicale du Canada, L (Canada)

Univ. Craiova, An., Ser. 3
Universitatea Craiova, Analе, Seria a 3: Biologie - Stiinte Agricole (Romania)

Urania (Krakow)
Urania (Krakow) (Poland)

Urology (N.Y.)
Urology (New York) (U.S.)

Usp. Fiz. Nauk
Uspekhi Fizicheskikn Nauk (U.S.S.R.)
Issued in English Translation as Soviet Physics- Uspekhi

Usp. Khim.
Uspekni Khimii (U.S.S.R.)
Issued in English Translation as Russian Chemical Reviews

Uzb. Biol. Zh.
Uzbekskii Biologicheskii Zhurnal, Akademiya Nauk Uzbekskoi SSR (Uzbek S.S.R.)

Uzb. Geol. Zh.
Uzbekskii Geologicheskii Zhurnal (Uzbek S.S.R.)

Uzb. Khim. Zh.
Uzbekskii Khimicheskii Zhurnal, Akademiya Nauk Uzbekskoi SSR (Uzbek S.S.R.)

V

Vacuum
Vacuum. The International Journal and Abstracting Service for Vacuum Research and Technology (England)

Vakuum-Tech.
Vakuum-Technik (West Germany)

Vannet Norden
Vannet i Norden (Norway)

VDI (Ver. Deut. Ing.) Ber.
VDI (Verein Deutscher Ingenieure) Berichte (West Germany)

VDI (Ver. Deut. Ing.) Nachr.
VDI (Verein Deutscher Ingenieure) Nachrichten (West Germany)

VDI (Ver. Deut. Ing.) Z.
VDI (Verein Deutscher Ingenieure) Zeitschrift fuer die Gesamte Technik
(Formerly VDI (Verein Deutscher Ingenieure) Zeitschrift) (West Germany)

Veiligheid
Veiligheid (Netherlands)

Verbraucherdienst
Verbraucherdienst (West Germany)

Verh. Deut. Ges. Inn. Med.
Verhandlungen der Deutschen Gesellschaft fuer Innere Medizin (West Germany)

Verh. Deut. Ges. Kreislaufforsch.
Verhandlungen der Deutschen Gesellschaft fuer Kreislaufforschung (West Germany)

Verh. Kon. Vlaam. Acad. Wetensch., Belg., Kl. Wetensch.
Verhandelingen van de Koninklijke Vlaamse Academie voor Wetenschappen, Letteren en Schone Kunsten van Belgie, Klasse der Wetenschappen (Belgium)

Verpackung (Leipzig)
Verpackung (Leipzig) (East Germany)

Versicherungsrecht
Versicherungsrecht (West Germany)

Versicherungswirtschaft
Versicherungswirtschaft (West Germany)

Vesmir
Vesmir (Czechoslovakia)

Vestn. Akad. Med. Nauk SSSR
Vestnik Akademii Meditsinskikh Nauk SSSR (U.S.S.R.)

Vestn. Akad. Nauk Kaz. SSR
Vestnik Akademii Nauk Kazakhskoi SSR (Kazakh S.S.R.)

Vestn. Akad. Nauk SSSR
Vestnik Akademii Nauk SSSR (U.S.S.R.)

Vestn. Beloruss. Gos. Univ., Ser. 2
Vestnik Belorusskogo Gosudarstvennogo Universiteta, Seriya 2. Biologiya, Khimiya, Geologiya, Geografiya (Belorussian S.S.R.)

Vestn. Dermatol. Venerol.
Vestnik Dermatologii i Venerologii (U.S.S.R.)

Vestn. Khir.
Vestnik Khirurgii imeni I. I. Grekova (U.S.S.R.)

Vestn. Leningrad. Univ., Fiz., Khim.
Vestnik Leningradskogo Universiteta, Fizika, Khimiya (Formerly Vestnik Leningradskogo Universiteta, Seriya Fiziki i Khimii) (U.S.S.R.)

Vestn. Leningrad. Univ., Mat., Mekh., Astron.
Vestnik Leningradskogo Universiteta, Matematika, Mekhanika, Astronomiya (Formerly Vestnik Leningradskogo Universiteta, Seriya Matematiki, Mekhaniki i Astronomii) (U.S.S.R.)

Vestn. Leningrad. Univ., Ser. Biol.
Vestnik Leningradskogo Universiteta, Seriya Biologii (U.S.S.R.)

Vestn. Mosk. Univ., Biol. Pochvoved.
Vestnik Moskovskogo Universiteta, Biologiya, Pochvovedenie (Continues in part Vestnik Moskovskogo Universiteta, Seriya Biologii, Pochvovedeniya, Geologii, Geografii) (U.S.S.R.)

Vestn. Mosk. Univ., Ser. II. Khim.
Vestnik Moskovskogo Universiteta, Seriya II. Khimiya (Formerly a Part of Vestnik Moskovskogo Universiteta, Seriya Matematiki, Mekhaniki, Astronomii, Fiziki i Khimii) (U.S.S.R.)

Vestn. Mosk. Univ., Ser. III. Fiz. Astron.
Vestnik Moskovskogo Universiteta, Seriya III. Fizika, Astronomiya (U.S.S.R.)

Vestn. Rentgenol. Radiol.
Vestnik Rentgenologii i Radiologii (U.S.S.R.)

Vestn. Slov. Kem. Drus.
Vestnik Slovenskega Kemijskega Drustva (Yugoslavia)

Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk
Vestsi Akademii Navuk Belaruskai SSR, Seryya Fizika-Energetychnykh Navuk (Belorussian S.S.R.)

Vestsi Akad. Navuk BSSR, Ser. Biyal. Navuk
Vestsi Akademii Navuk BSSR, Seryya Biyalagichnykh Navuk (Formerly Carried as Vestsi Akademii Navuk Belaruskai SSR, Seryya Biyalagichnykn Navuk) (Belorussian S.S.R.)

Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk
Vestsi Akademii Navuk Belaruskai SSR, Seriya Fizika-Energetychnykh Navuk (Belorussian S.S.R.)

Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk
Vestsi Akademii Navuk BSSR, Seryya Fizika-Matematychnykh Navuk (Belorussian S.S.R.)

Vestsi Akad. Navuk BSSR, Ser. Fiz.-Tekh. Navuk
Vestsi Akademii Navuk BSSR, Seryya Fizika-Tekhnichnykh Navuk (Belorussian S.S.R.)

Vestsi Akad. Navuk BSSR, Ser. Khim. Navuk
Vestsi Akademii Navuk BbSR, Seryya Khimichnykh Navuk (Belorussian S.S.R.)

Veterinariya
Veterinariya (U.S.S.R.)

Vet. Med. (Prague)
Veterinarni Medicina (Pragus) (Czechoslovakia)

Vet. Med. Nauki (Sofia)
Veterinarno Meditsinski Nauki (Sofia), Izvestiya na Akademiyata na Selskostopanskite Nauki (Bulgaria)

Vet. Sb.
Veterinarna Sbirka (Bulgaria)

VGB Kraftwerkstechnik
VGB Kraftwerkstechnik (West Germany)

Vide
Vide, Le, Technique-Applications (France)

Vidya
Vidya (India)

Vie Med. Can. Fr.
Vie Medicale au Canada Francais, La (Canada)

Virchows Arch., B
Virchows Archiv, B. Zellpatnologie (Formerly Frankfurter Zeitschrift fuer Pathologie) (West Germany)

Virology
Virology (U.S.)

Vishwakarma
Vishwakarma (India)

Visn. Kharkiv. Univ., Astron.
Visnik Kharkivs'kogo Universitetu, Astronomiya (Ukrainian S.S.R.)

Visn. Kharkiv. Univ., Radiofiz.
Visnik Kharkivs'kogo Universitetu, Radiofizika (Ukrainian S.S.R.)

Visn. Kharkiv. Univ., Radiofiz. Elektron.
Visnik Kharkivs'kogo Universitetu, Radiofizika i Elektronika (Ukrainian S.S.R.)

Visn. Kiiv. Univ., Ser. Biol.
Visnik Kiivs'kogo Universitetu, Seriya Biologii (Ukrainian S.S.R.)

Visn. L'viv. Derzh. Univ., Ser. Khim.
Visnik L'vivs'kogo Derzhavnogo Universitetu im. Ivana Franka, Seriya Khimichna (Ukrainian S.S.R.)

Vistas Astron.
Vistas in Astronomy (England)

Vitis
Vitis (West Germany)

Vnitr. Lek.
Vnitrni Lekarstvi (Czechoslovakia)

Vod. Hospod., B
Vodni Hospodarstvi, B (Czechoslovakia)

Vodosnabzn. Sanit. Texn.
Vodosnabzhenie i Sanitarnaya Tekhnika (U.S.S.R.)

Voenno Med. Delo
Voenno Meditsinsko Delo (Bulgaria)

Voenno-Med. Zh.
Voenno-Meditsinskii Zhurnal (U.S.S.R.)

Vojnosanit. Pregl.
Vojnosanitetski Pregled (Yugoslavia)

Voj. Zdravot. Listy
Vojenske Zdravotnicke Listy (Czechoslovakia)

Vop. Istor. Estestvozn. Tekh.
Voprosy Istorii Estestvoznaniya i Tekhniki (U.S.S.R.)

Vop. Kurortol., Fizioter. Lech. Fiz. Kul't.
Voprosy Kurortologii, Fizioterapii i Lechebnoi Fizicheskoi Kul'tury (U.S.S.R.)

Vop. Med. Khim.
Voprosy Meditsinskoi Khimii (U.S.S.R.)

Vop. Onkol.
Voprosy Onkologii (U.S.S.R.)

Vop. Pitan.
Voprosy Pitaniya (U.S.S.R.)

Vop. Virusol.
Voprosy Virusologii (U.S.S.R.)

Vrach. Delo
Vrachebnoe Delo (Ukrainian S.S.R.)

Vychisl. Sist.
Vychislitel'nye Sistemy (U.S.S.R.)
Issued in English Translation as Computer Elements and Systems (USSR)

Vysokomol. Soedin.
Vysokomolekulyarnye Soedineniya (Divided into Vysokomolekulyarnye Soedineniya, Seriya A, and Vysokomolekulyarnye Soedineniya, Seriya B) (U.S.S.R.)

Vysokomol. Soedin., Ser. A
Vysokomolekulyarnye Soedineniya, Seriya A (Continues in Part Vysokomolekulyarnye Soedineniya) (U.S.S.R.)
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